

ASTRONOMY

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OBSERVER's GUIDE

How To See:

- Stars & planets
- Eclipses
- Meteor showers

How To Buy:

- Telescopes
- Eyepieces
- Binoculars
- Astronomy software
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ON THE EVENING OF August 21, 1993, Steve Bisque in **GOLDEN, COLORADO** established modem contact with the 24-inch telescope at the Mt. Wilson Observatory *outside* *Pasadena...*

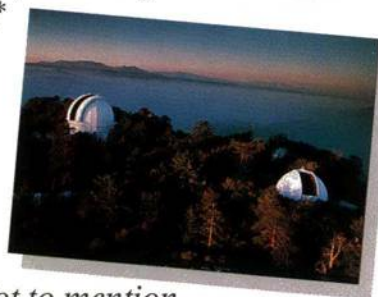
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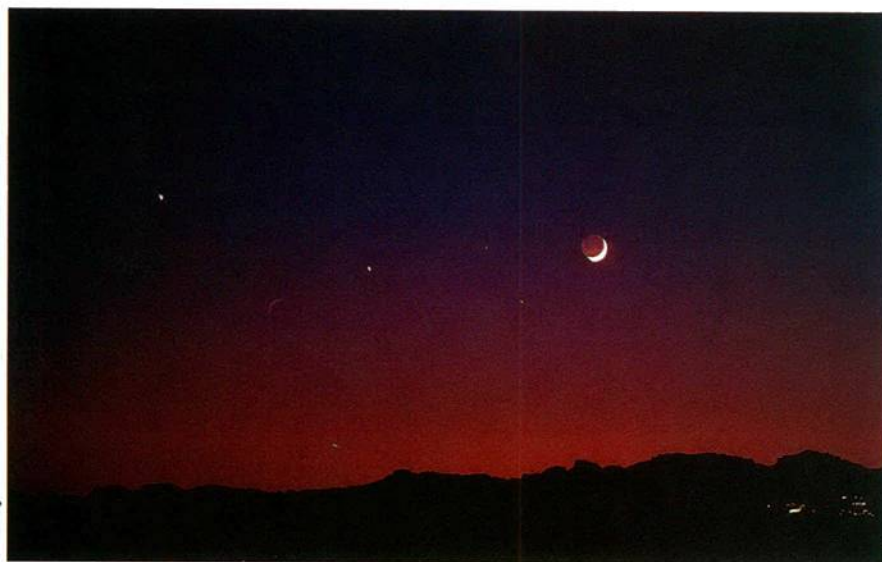
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OBSERVER'S GUIDE

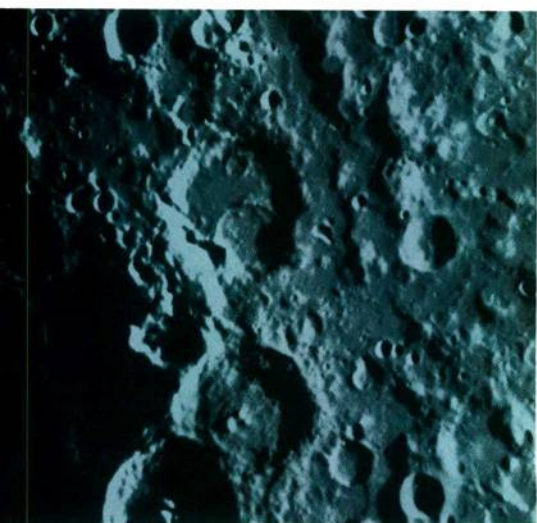
1 9 9 5



Ivan Dyer

6 1995 Sky Guide

Every observer needs a calendar of sky events. Look here for dates and times to view stars and planets, solar and lunar eclipses, meteor showers, and other must-see events of the coming year. By David J. Eicher and Richard Talcott.



Gerard Thérin

22 Shopping for a Telescope

Whether buying a first telescope or a fifth, making a wise purchase calls for information. We have full specs on over 250 telescope models. By Alan Dyer.

41 Accessories for Scopes

Eyepieces, mountings, flashlights, tool kits — they're all here. A complete directory to all the extras that make exploring the heavens a joy. By Alan Dyer.

53 Buying Binoculars

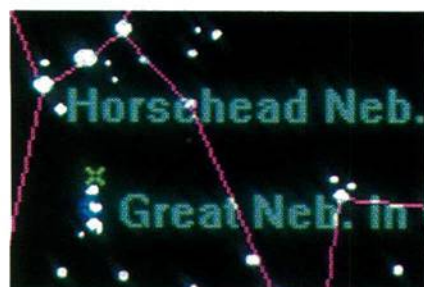
Often underrated or ignored by beginners, binoculars are the amateur astronomer's greatest friend. Finding the best for your needs is easy. By Alan Dyer.

64 Computers & Astronomy

Powerful software can show you the night sky from anywhere on Earth, thousands of years into the past or future. Or let you take a trip to Mars via CD-ROM. Or capture a galaxy with a CCD camera. Full listings of all the latest software. By David Bruning.

82 Space Places

Ever wanted to party with the stars? Visit an observatory? Take in the sky show at a planetarium? Here's a rundown of space places to make that next trip an unforgettable adventure. Plus — a complete listing of local astronomy clubs across North America. By Tracy Staedter.



ASTRONOMY: Darla Evans



Bill and Sally Fletcher

Discover Astronomy

Amateur astronomy is one of the most exciting activities in the world — or out of it! The staff of *ASTRONOMY* has assembled the *Observer's Guide* to help everyone explore this fascinating part of the natural world. It pulls together all the basic information necessary for beginners and oldtimers alike. We started with the assorted guides to sky events, telescopes, accessories, and software that we have been publishing annually and brought them all up-to-date. The result is the most complete and thorough info on the market.

But there's a lot more here than just listings of equipment specs. For example, the first section provides a detailed observer's calendar for 1995. Written with both naked-eye viewers and telescope owners in mind, it tells all about the coming year's celestial events and has lots of photos and diagrams and dates and times so you won't miss anything important.

Likewise, buying a first telescope can be a scary experience. So we'll walk you through it, step by step. And if you need advice on choosing a telescope for a child, we'll describe what features to look for and how to know when he or she is ready. Eyepieces, binoculars, and other accessories? You'll find handy advice on choosing and using them — and they're all grouped to make comparing their features easy.

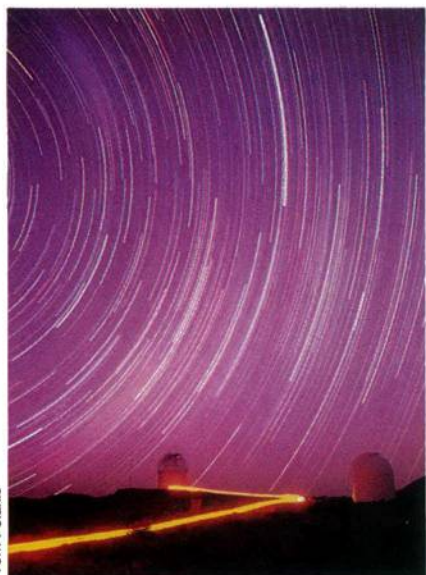
Computers, software, and electronic picture-taking are relatively new to amateur astronomy, but the field is growing rapidly. Our new write-up tells what's going on and reflects all the latest changes.

Want to get social? Check out a star party or an astronomy club. Star parties are gatherings where amateur astronomers stay up all night, look through lots of different telescopes, and talk astronomy far into the wee hours. The directory starting on page 82 will tell you where to go (and when) to get in on the fun. Other "space places" such as observatories and planetariums add a different dimension to astronomy — one that other members of the family can share in, too.

Thousands of amateur astronomers now form a world-wide community of explorers of the universe. *ASTRONOMY's Observer's Guide 1995* is your passport to join them in a lifelong adventure. We hope you enjoy it!



George Greaney



Tom Polakis

99 Sky Words & Sky Books

To learn more, turn here. Includes a glossary to demystify astro-speak so you'll know what amateur astronomers are *really* saying. By Richard Talcott and David J. Eicher.

Cover: The Great Galaxy in Andromeda (M31) is a near-twin to the Milky Way and the most distant object you can see with the naked eye. Backyard astronomer George Greaney took its photograph with two 1-hour exposures on hypersensitized Fuji Super HG 400 film, sandwiched and printed onto slide film. His telescope was a 5-inch, f/5.9 refractor.

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ASTRONOMY'S 1995 SKYGUIDE

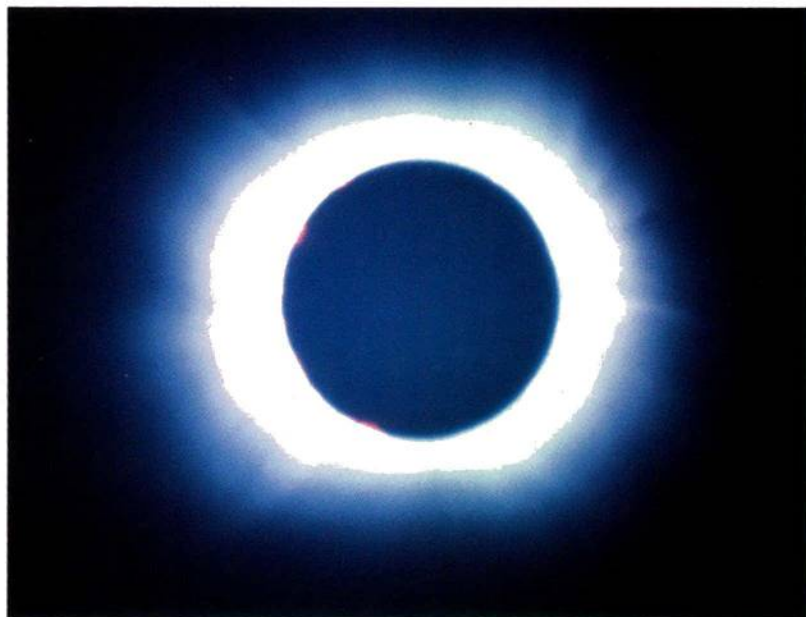
This year brings spectacular eclipses, meteors, comets, vanishing rings, and great performances by Mars and Jupiter.

You wake early, rub your eyes, slip into warm clothes, and wander out onto the deck, your coffee mug steaming in your hands. It's early and cold, and the January sky fills your eyes with glistening lights. Before dawn's early light you turn and see brilliant Venus climbing in the east, casting such a glow that it snaps your fuzzy eyes into focus.

L.H. Price



Such mornings provide an opportunity to watch Venus as it arcs across the southeastern morning sky in a wonderful apparition. But Venus is not the only planet putting on a show this year. For the



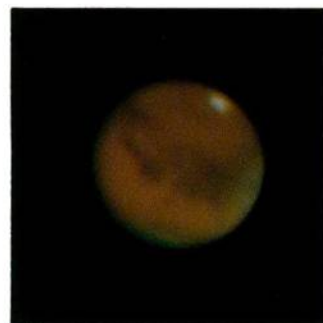
Fred Espenak

first three months of 1995 the Red Planet Mars will be enough to make the dark markings on its surface easily visible in backyard telescopes. Moreover, it is visible all night long in February. Later in the year, in May and June, Jupiter will outshine the summer stars in the evening sky as it floats north of

Antares, the bright orange star in Scorpius.

Last year skygazers received a rare observational treat when Comet Shoemaker-Levy 9 smashed into Jupiter. This year's rare planetary occurrence happens every 15 years or so when Earth passes through the ring-plane of Saturn. During both May and August, Saturn's rings will tilt edge-on to our line of sight and disappear from view.

But of course planets alone do not a solar system make. Armed with a pair of binoculars or a small telescope, you'll get several chances this year to view bright comets and asteroids. These include periodic Comet d'Arrest, best visible in July, and the



Don Parker

asteroid Iris, brightest in December.

The Earth and Moon dance in each other's shadows this year, creating three memorable eclipses. An annular solar eclipse will cast a "ring of fire" over South America in April; October brings a total solar eclipse to southern Asia. North Americans must be content with a partial lunar eclipse visible from the western half of the continent.

Gary Becker



Philip J. Lambert

January

S	M	T	W	T	F	S
●	2	3	4	5	6	7
●	9	10	11	12	13	14
15	○	17	18	19	20	21
22	●	24	25	26	27	28
29	●	31				

Day Time (EST)

- 1 9 p.m.**
Mercury passes
3° south of Neptune
(evening)
- 3 8 p.m.**
Mercury passes
1.7° south of Uranus
(evening)
Mars is stationary
**Quadrantid meteors
peak**
- 13 7 a.m.**
**Venus reaches great-
est western elonga-
tion (47°, morning)**
12 noon
Neptune is in conjunc-
tion with the Sun
(behind the Sun)
- 14 4 a.m.**
**Venus passes
3° north of Jupiter
(morning)**
- 16 7 p.m.**
Uranus is in conjunc-
tion with the Sun
(behind the Sun)
- 19 3 a.m.**
**Mercury reaches
greatest eastern
elongation (19°,
evening)**
- 22 8 p.m.**
Jupiter passes
5° north of Antares
(morning)
- 25 7 a.m.**
Mercury is stationary
- 27 7 a.m.**
**The Moon passes
0.2° north of Venus**

Events in **bold** are celestial highlights.

All times in the calendars are eastern time. "Morning" or "evening" at the end of a listing denotes that the event appears after sunset or before dawn, respectively.

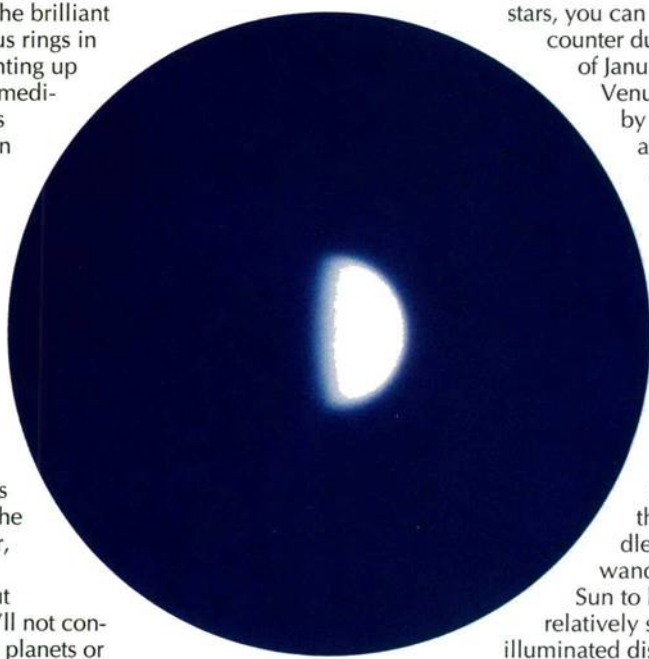
SEE VENUS IN THE MORNING SKY

Masquerading as the brilliant "morning star," Venus rings in the New Year by lighting up the predawn sky. Immediately recognizable as the brightest object in the night sky (save for the Moon), it impresses everyone who sees it. And this year provides ample opportunity for early risers to watch the planet in the southeastern predawn (morning) sky.

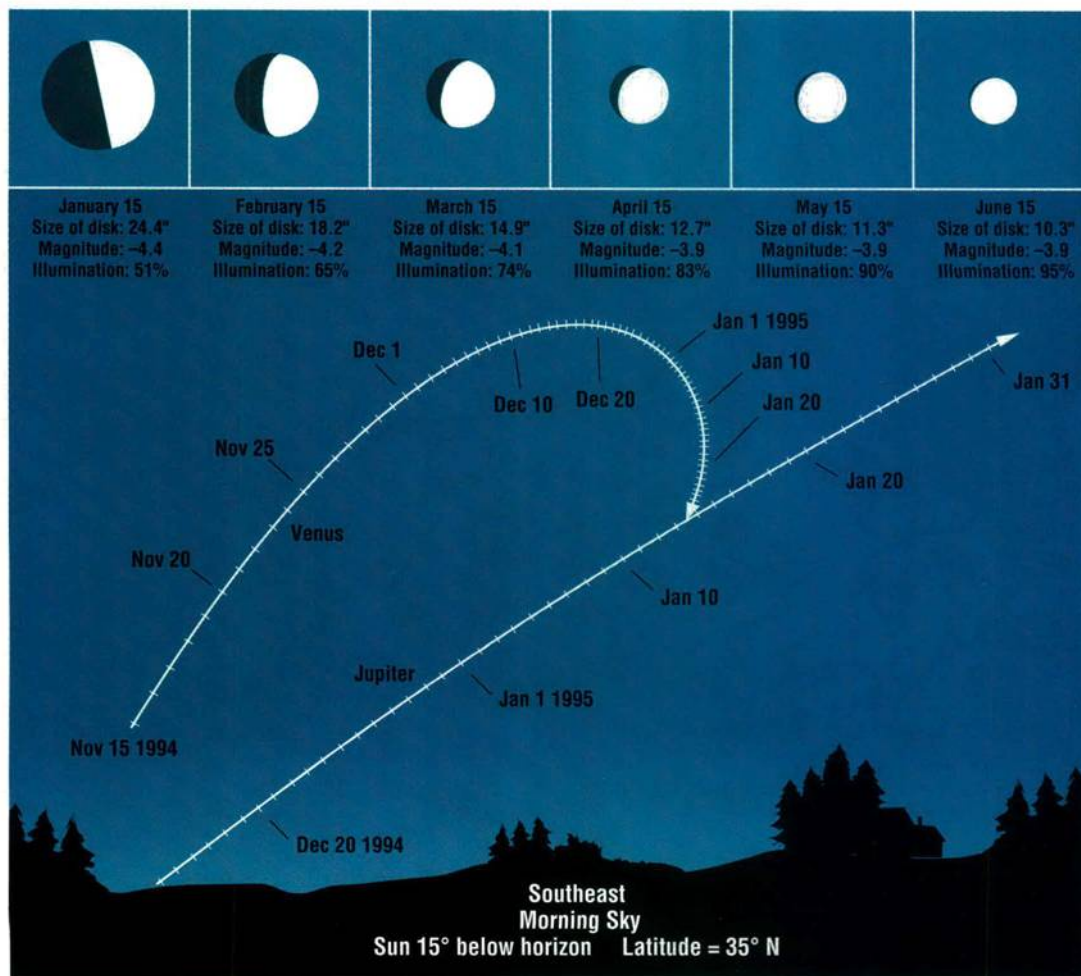
Having reached its peak altitude above the horizon in December, Venus slowly curves southward throughout January. Though you'll not confuse it with any other planets or

stars, you can see a magnificent encounter during the middle days of January. At this time Venus and Jupiter swing by each other, separated at their closest by only 3° on the morning of the 14th.

You may also wish to view Venus' pretty phases in a telescope. The planet changes from a half-lit "first quarter" phase in mid-January to an increasingly illuminated disk later in the year. By the middle of the year, when it wanders too close to the Sun to be seen, Venus is a relatively small, almost fully illuminated disk.



Charles F. Capen

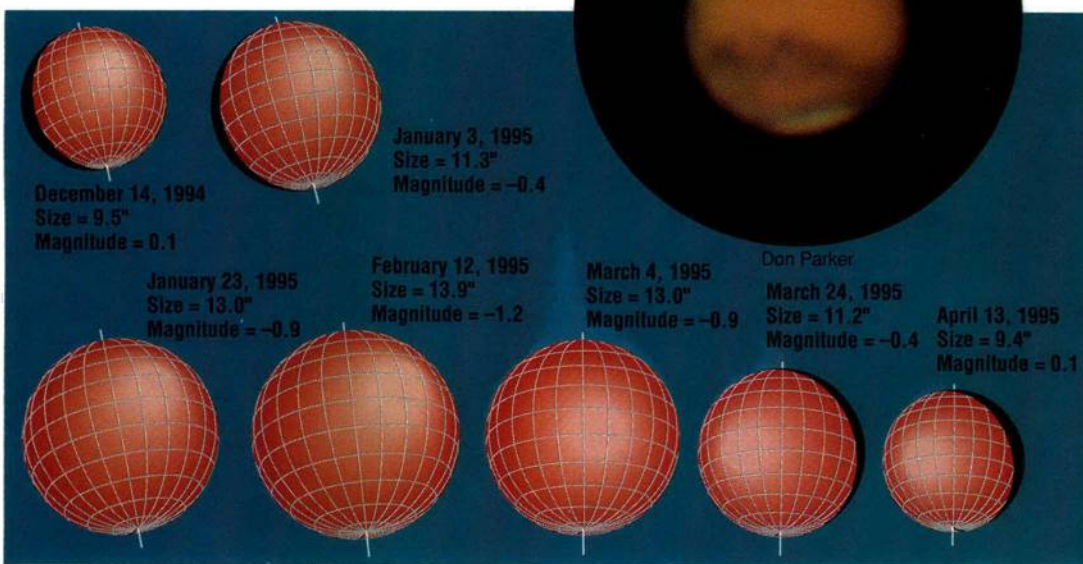


THE RED PLANET HIGHLIGHTS THE EVENING SKY

The crisp evenings of winter and early spring bring with them a host of bright stars: Sirius, Betelgeuse, Rigel, and Regulus, to name just a few. But this year Mars intrudes into that familiar evening tapestry, outshining all the stars save for Sirius. The Red Planet reaches opposition, the peak of its biennial apparition when it stands opposite the Sun in our sky and is visible all night long, on the night of February 11/12.

While this is the poorest apparition for Mars in 15 years, the good news is that even still, Mars

shines brightly and offers a lot to telescopic observers. The best time to view Mars in a telescope is when its disk appears larger than 10" across. By this rule you have over three months of prime viewing this apparition — from December 20 of last year to April 5 this year. A 3- or 4-inch telescope will show you the Martian polar caps and the largest dark markings, while a 6- to 8-inch scope will start to bring out the more subtle dusky markings that characterize the Red Planet's surface.

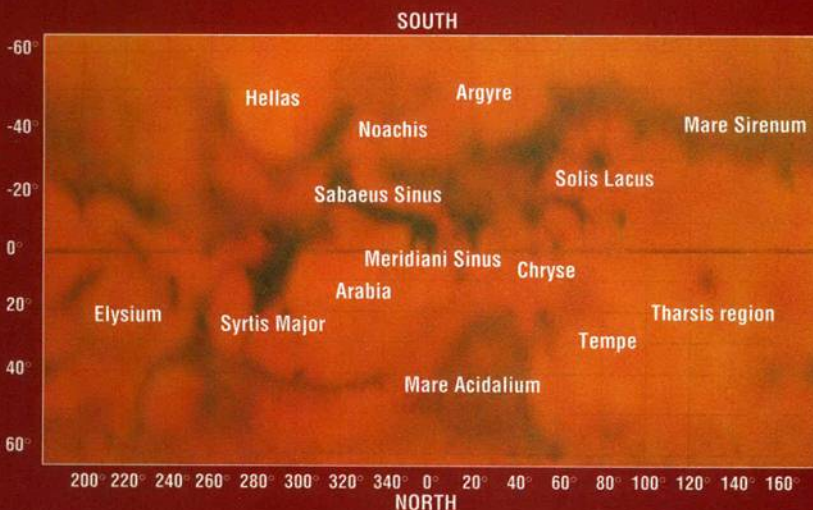


ASTRONOMY: Phil Kirchmeier

MARTIAN CENTRAL MERIDIANS

These longitudes will be centered on Mars' disk at 11 p.m. EST.

Jan. 1	191°
Jan. 7	137°
Jan. 13	83°
Jan. 19	30°
Jan. 25	337°
Jan. 31	284°
Feb. 6	232°
Feb. 12	180°
Feb. 18	127°
Feb. 24	75°
Mar. 2	22°
Mar. 8	329°
Mar. 14	275°
Mar. 20	221°
Mar. 26	166°
Apr. 1	111°



To find the central meridian at other times, subtract 9.1° for each day after a tabulated date and add 14.6° for each hour after a tabulated hour.

February

S	M	T	W	T	F	S
			1	2	3	4
5	6	7	8	9	10	11
12	13	14	15	16	17	18
19	20	21	22	23	24	25
26	27	28				

Day Time (EST)

- 2 3 a.m.
The Moon passes 6° north of Saturn
- 8 p.m.
Asteroid Ceres is at opposition
- 3 6 p.m.
Mercury is in inferior conjunction
- 11 9 a.m.
Mars is closest to Earth
- 10 p.m.
Mars is at opposition
- 15 5 a.m.
The Moon passes 10° south of Mars
- 2 p.m.
Mercury is stationary
- 22 12 midnight
The Moon passes 2° north of Jupiter
- 25 12 midnight
The Moon passes 4° north of Venus
- 26 5 a.m.
Venus passes 0.7° north of Neptune (morning)
- 27 6 a.m.
The Moon passes 5° north of Mercury

Events in **bold** are highlights you won't want to miss.

S	M	T	W	T	F	S
			●	2	3	4
5	6	7	8	●	10	11
12	13	14	15	○	17	18
19	20	21	22	●	24	25
26	27	28	29	●	31	

Day Time (EST)

- 1 **6 a.m.**
Mercury reaches greatest western elongation (27°, morning)
- 2 **midnight**
Venus passes 1.5° north of Uranus (morning)
- 3 **Look for very young Moon in western sky after sunset**
- 5 **9 p.m.**
Saturn is in conjunction with the Sun (behind the Sun)
- 6 **5 a.m.**
Pluto is stationary
- 20 **9 p.m.**
Equinox (northern spring/southern autumn begins)
- 22 **9 a.m.**
The Moon passes 2° north of Jupiter (morning)
- 23 **8 a.m.**
Asteroid Ceres is stationary
- 25 **12 noon**
Mars is stationary
- 7 **p.m.**
Mercury passes 0.6° south of Saturn (morning)

Events in **bold** are highlights you won't want to miss.

SPOT A VERY YOUNG MOON

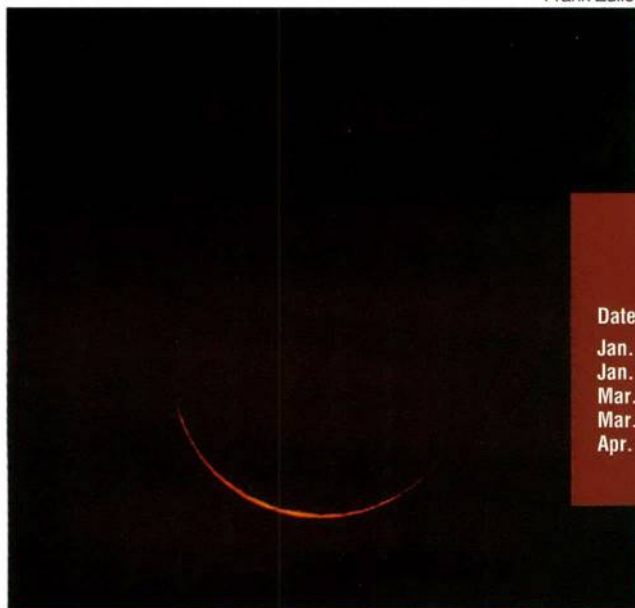
The Moon teases us with its never-ceasing cycle of phases and steady motion through the sky. We always see it in some form during some part of the night, except when it sneaks in front of the Sun at New Moon. Spotting a very young Moon, one day or even hours after this time, offers the chance for naked-eye skywatchers to challenge their visual acuity. How "young" a Moon can you see?

March offers a superb opportunity for spotting a young Moon because the ecliptic — the apparent

path of the planets — angles sharply above the horizon. This means the young Moon, rimmed by a slender crescent of light and newly emerged from its New Moon phase, is easier to see than at other times during the year.

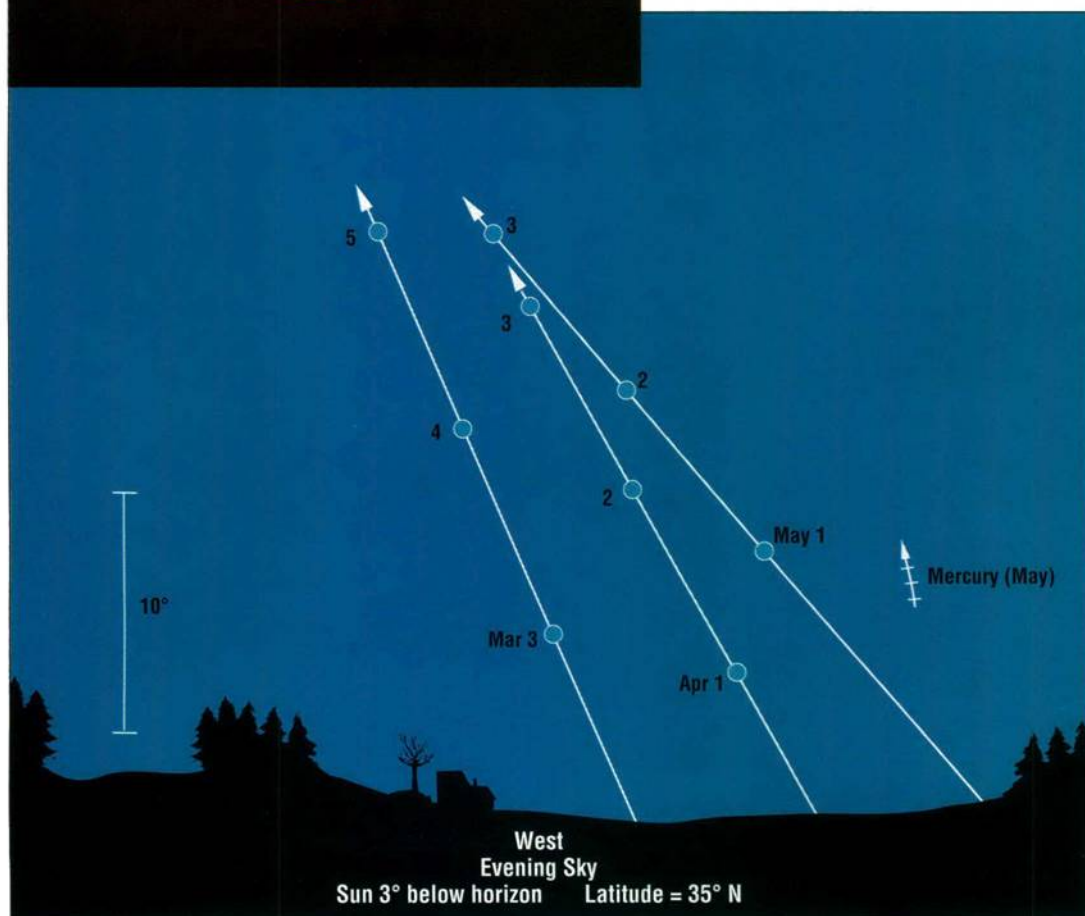
To catch this month's young Moon, take a pair of binoculars just after sunset on the evening of March 3. Choose a site with a clear, flat horizon and face west. As twilight settles into semi-darkness, scan the sky just above the horizon for the Moon, using binoculars if necessary. If you don't spot the Moon on March 3, try again on the 4th or 5th when it will be higher in the sky and thus easier to see. You can also go after young Moons during the first days of April and May.

Frank Zullo



DATES TO LOOK FOR A THIN CRESCENT MOON

Date	Age	The age is for the east coast of the United States at sunset. From locations farther west in North America, the Moon will have "aged" some more by the time the Sun sets.
Jan. 1	11.5 hours	
Jan. 31	24 hours	
Mar. 1	11.5 hours	
Mar. 31	21.5 hours	
Apr. 30	30.5 hours	



ANNULAR ECLIPSE OVER SOUTH AMERICA



APRIL 25 ANNULAR SOLAR ECLIPSE

Cities within path of annularity	Time (UT) of maximum eclipse	Length of annularity	Sun's altitude
Belém, Brazil	19h06m	5m22s	30°
Fortaleza, Brazil	19h17m	3m55s	17°
Loja, Ecuador	17h34m	3m31s	71°
Piura, Peru	17h27m	6m26s	70°
São Luís, Brazil	19h11m	4m16s	24°

The memory of last May's annular solar eclipse, which cut a wide swath across North America, is still fresh in most observers' minds. For those hooked on the sight of seeing the Sun reduced to a



Phil Lohmann

thin ring, or annulus, of light, April 29 brings another opportunity. But to see this eclipse, you either have to live in or travel to northern South America.

The Moon's shadow first touches land in the early afternoon near the border between Peru and Ecuador, where it plunges the town of Piura, Peru, into near darkness for over six minutes. Maximum

eclipse occurs about 100 miles northeast of Piura, high up in the Andes Mountains. There the Moon covers 95 percent of the Sun (one percent more than during the May '94 eclipse) for 6 minutes 37 seconds. After crossing mostly uninhabited regions of northern Peru and southern Colombia, the track heads nearly due east across the equally uninhabited and inaccessible Amazon River basin of northern Brazil. The Moon's shadow then hugs the northern coast of Brazil before heading into the western Atlantic.

Because the Moon won't completely cover the Sun at any time, observers of this eclipse must protect their eyes. You can either look through a proper solar filter or view a projected image of the Sun.

A LUNAR ECLIPSE FOR NORTH AMERICA

The Moon isn't the only solar system object casting its shadow onto another in April — the Moon itself passes through the shadow of Earth on the night of April 14/15. Observers in the western half of North America, the Pacific Ocean, Australia, New Zealand, and eastern Asia will see Earth's shadow creep across the northern limb of the Full Moon that night. At the peak of the eclipse, 12 percent of the Moon will be in darkness.

For viewers in North America, the eclipse gets underway at 6:41 a.m. CDT (5:41 a.m. MDT, 4:41 a.m. PDT), when the shadow takes its first perceptible bite out of the Moon. Anyone in Mexico or west of a line that runs through central Louisiana, western Arkansas, the eastern borders of Kansas, Nebraska, and the Dakotas, and central Manitoba, will see this first stage of the eclipse. The amount of the Moon covered will gradually increase until maximum eclipse comes

at 7:18 a.m. CDT (6:18 a.m. MDT, 5:18 a.m. PDT). The eclipse then wanes for the next 37 minutes, until the shadow leaves the Moon's surface at 7:55 a.m. CDT (6:55 a.m. MDT, 5:55 a.m. PDT). The entire eclipse will be seen by those west of a line running through western Mexico, central Arizona, Utah, and Idaho, and eastern British Columbia.

Because the eclipse occurs near sunrise, the Moon will be lying low in the west, which will present some nice photo opportunities. Before the eclipse, scout around for a pretty landscape you can shoot while facing west. Then on eclipse morning, mount a 35mm camera on a sturdy tripod and capture the eclipsed Moon hanging a foreground lit by twilight.



Ivan Dryer

April

S	M	T	W	T	F	S
						1
2	3	4	5	6	7	8
9	10	11	12	13	14	15
16	17	18	19	20	21	22
23	24	25	26	27	28	29
30						

Day Time (EDT)

- 1 8 a.m.**
Jupiter is stationary
- 2 2 a.m.**
Daylight saving time begins
- 10 10 a.m.**
The Moon passes 8° south of Mars
- 13 1 p.m.**
Venus passes 0.6° north of Saturn (morning)
- 14 9 a.m.**
Mercury is in superior conjunction
- 15 8 a.m.**
Partial lunar eclipse
- 18 5 p.m.**
The Moon passes 3° north of Jupiter
- 22** Lyrid meteors peak (Last Quarter Moon)
- 25 9 p.m.**
The Moon passes 6° north of Saturn
- 27 1 a.m.**
The Moon passes 4° north of Venus
5 p.m.
Neptune is stationary
- 29 2 p.m.**
Annular solar eclipse (South America)

Events in **bold** are highlights you won't want to miss.

May

S	M	T	W	T	F	S
	1	2	3	4	5	6
●	8	9	10	11	12	13
○	15	16	17	18	19	20
●	22	23	24	25	26	27
28	●	30	31			

Day Time (EDT)

- 5 7 a.m.**
Uranus is stationary
Eta Aquarid meteors peak (First Quarter Moon)
- 11 10 p.m.**
Mercury reaches greatest eastern elongation (22°, evening)
- 15 10 p.m.**
The Moon passes 2° north of Jupiter
- 18 9 p.m.**
The Moon passes 5° north of Neptune
- 19 6 a.m.**
The Moon passes 6° north of Uranus
- 20 1 p.m.**
Pluto is at opposition
- 22 4 a.m.**
Earth passes through the ring-plane of Saturn
- 24 3 a.m.**
Mars passes 1.1° north of Regulus
12 noon
Mercury is stationary
- 27 3 a.m.**
The Moon passes 0.8° north of Venus

Events in **bold** are highlights you won't want to miss.

ENJOY A METEOR SHOWER

Few sky events cause the heart to beat as fast as a good meteor shower. The unpredictability of a bright meteor shooting overhead draws thousands outdoors braced against the cold with sleeping bags and armed with hot coffee, to witness the glory of cometary particles falling into Earth's atmosphere and vaporizing. Unfortunately, this year is a poor one for what are normally the two best showers, the Perseids

of August and Geminids of December. A nearly Full Moon substantially hinders viewing either of these stalwart events.

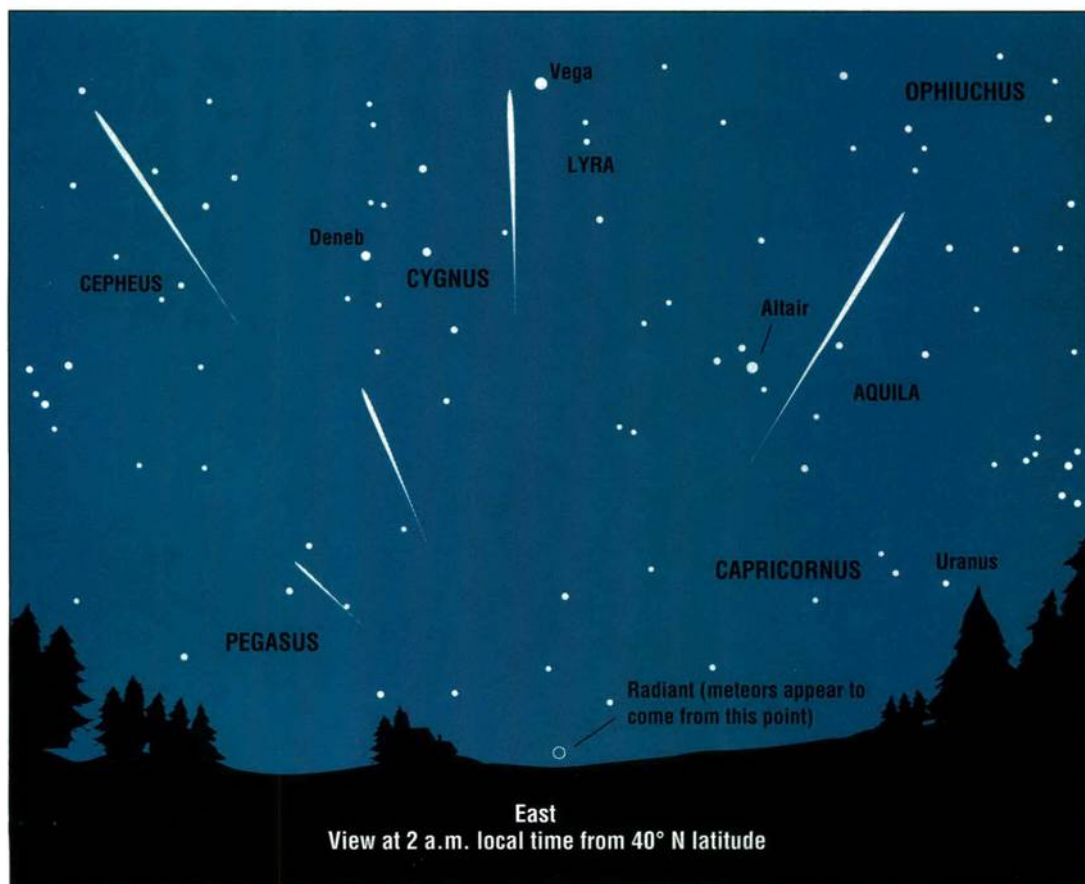
This year the Moon is just a few days old during the peak of the Eta (η) Aquarid shower, an active display that produces one meteor every couple of minutes at its peak. The Moon will therefore set in the evening, long before the best hours for meteor viewing. For the best view of the Eta

Aquarids, venture out in the early morning hours of May 5, when Earth's rotation places its nightside head on into the cloud of meteors. Fancy equipment isn't necessary either: Simply lie back, relax, look straight up. To capture a meteor on film, load your camera with fast film, attach a wide-field lens, focus the camera at infinity, mount it on a tripod, and open the shutter for periods of 15 to 30 minutes at a time. That will produce trailed stars and capture meteors that happen to streak through the field of view.

METEOR SHOWERS IN 1995

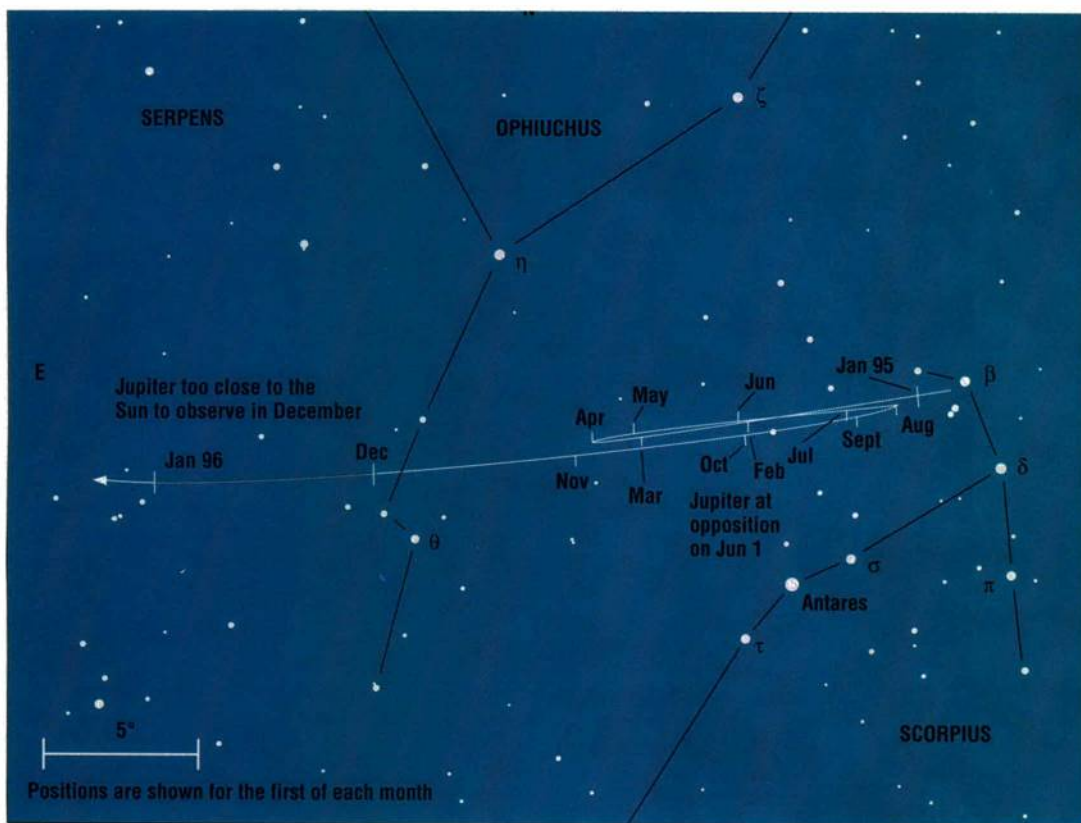
Shower	Date	Rate (#/hr.)	Viewing Conditions
Quadrantids	Jan. 3/4	85	Very good
Lyrids	Apr. 21/22	15	Fair
η Aquarids	May 4/5	30	Very good
S. δ Aquarids	July 28	20	Very good
Perseids	Aug. 12	100	Poor
Orionids	Oct. 21/22	20	Good
S. Taurids	Nov. 3	15	Fair
N. Taurids	Nov. 13	15	Poor
Leonids	Nov. 17	12	Poor
Geminids	Dec. 13/14	95	Poor

Viewing conditions depend on whether the Moon is present and the peak of the shower occurs at night for North America.



A BEACON IN THE SUMMER SKY

ASTRONOMY: Phil Kirchmeier

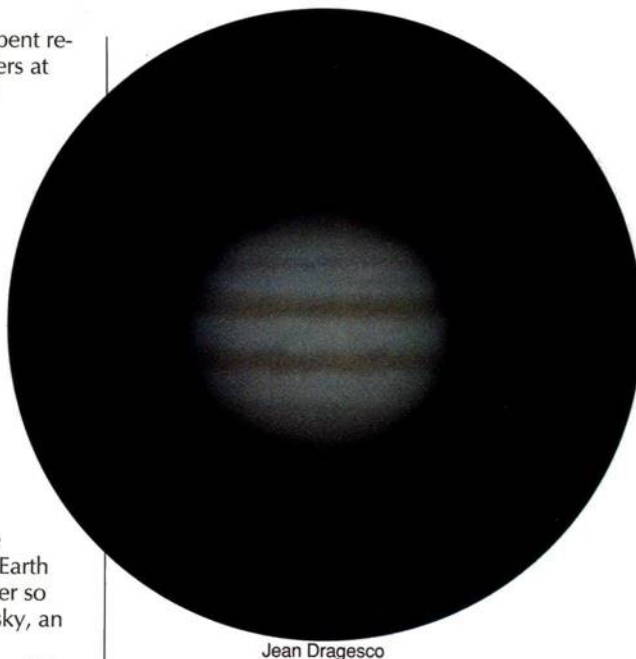


Summer brings to mind warm evenings spent relaxing outdoors and, to backyard astronomers at least, images of the glorious summer Milky Way. This summer offers all of that and more, as the planet Jupiter dazzles the naked eye from its position against the rich background of Scorpius and Ophiuchus. Jupiter will appear at its best both visually and telescopically during May and June.

Jupiter begins the year in northern Scorpius, just 2° east of the bright star Beta (β) Scorpii. It then rises about three hours before the Sun and appears low in the southeast as twilight brightens. As winter fades to spring and spring to summer, Jupiter comes up earlier and grows brighter. The peak of its 1995 apparition comes on June 1 when the giant planet rises at sunset, appears highest in the south around midnight, and sets at sunrise. Earth then lies directly between the Sun and Jupiter so the planet appears opposite the Sun in our sky, an alignment called opposition.

At opposition Jupiter shines at magnitude -2.6, making it brighter than any other object in the night sky besides the Moon and Venus. It then lies about 5° north of Antares, a ruddy, 1st-magnitude star that is normally the brightest object in this part of the sky but which pales in comparison with Jupiter.

Jupiter also lies closest to Earth at opposition, so



Jean Dragesco

in a telescope it appears larger than at any other time of the year, 45.5" across. In a 3-inch scope at about 100x, you should see at least two dark cloud belts girdling the planet's equator. In a larger scope you'll see some of the more subtle belts that lie closer to the poles and perhaps a hint of pinkish color in the oval Great Red Spot.

June

S	M	T	W	T	F	S
				1	2	3
4	5	6	7	8	9	10
11	12	13	14	15	16	17
18	19	20	21	22	23	24
25	26	27	28	29	30	

Day Time (EDT)

- 1 7 a.m.**
Jupiter is at opposition
- 5 1 a.m.**
Mercury is in inferior conjunction
4 p.m.
The Moon passes 6° south of Mars
- 12 4 a.m.**
The Moon passes 2° north of Jupiter
- 15 5 p.m.**
Mercury passes 1.2° north of Aldebaran (morning)
- 17 2 a.m.**
Mercury is stationary
- 18 10 a.m.**
Mercury passes 1.1° north of Aldebaran (morning)
11 a.m.
Asteroid Juno is at opposition
- 19 3 a.m.**
Mercury passes 4° south of Venus (morning)
3 p.m.
The Moon passes 6° north of Saturn
- 21 5 p.m.**
Solstice (northern summer/southern winter begins)
- 25 10 p.m.**
The Moon passes 0.6° north of Mercury
- 26 11 a.m.**
The Moon passes 3° south of Venus
- 29 noon**
Mercury reaches greatest western elongation (22°, morning)

Events in **bold** are highlights you won't want to miss.

July

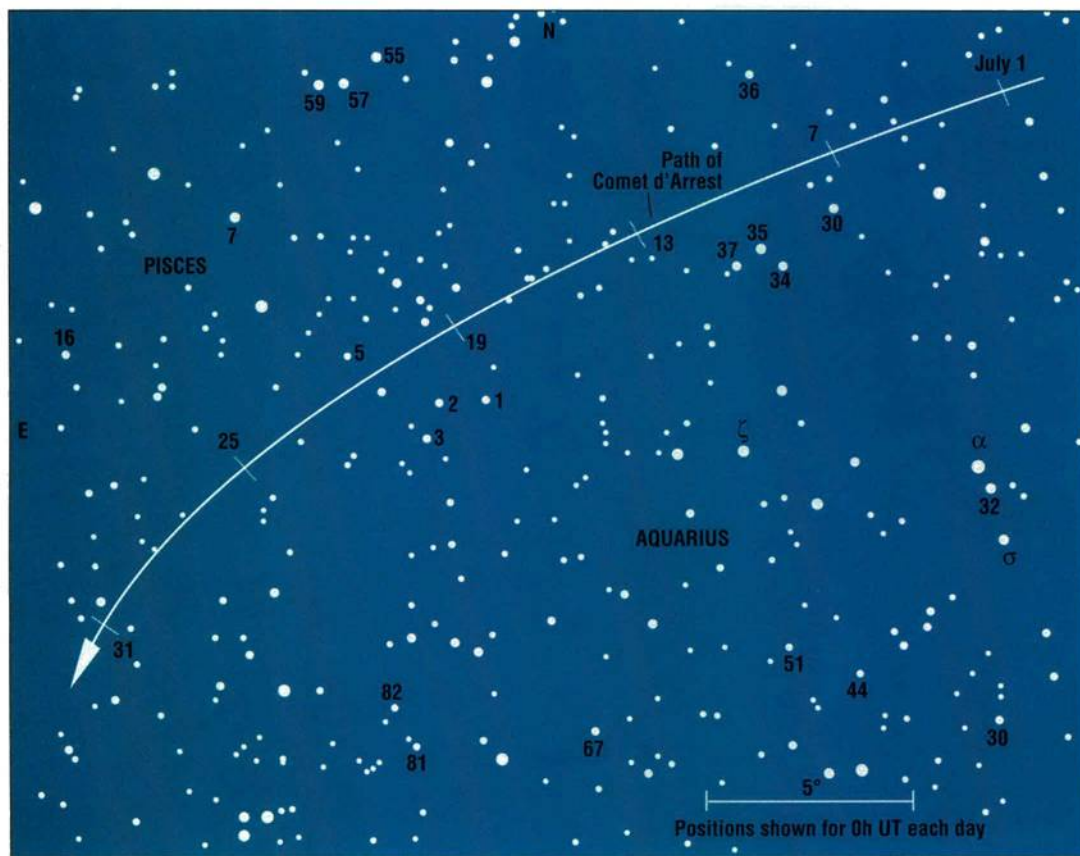
S	M	T	W	T	F	S
						1
2	3	4	5	6	7	8
9	10	11	12	13	14	15
16	17	18	19	20	21	22
23	24	25	26	27	28	29
30	31					

Day Time (EDT)

- 4 1 a.m.**
The Moon passes
4° south of Mars
- 7 7 a.m.**
Saturn is stationary
- 9 9 a.m.**
The Moon passes
2° north of Jupiter
- 12 3 p.m.**
The Moon passes
4° north of Neptune
- 11 p.m.**
The Moon passes
6° north of Uranus
- 17 midnight**
The Moon passes
6° north of Saturn
- 1 a.m.**
Neptune is at
opposition
- 21 2 p.m.**
Uranus is at
opposition
- 27 10 p.m.**
Mercury is in superior
conjunction (behind
the Sun) Comet
d'Arrest reaches
perihelion
- 28 Southern Delta**
Aquarid meteors
peak (New Moon)

Events in **bold** are
highlights you won't
want to miss.

OBSERVE THE RETURN OF COMET D'ARREST



ASTRONOMY: Lee Vande Visse



Bill Gordon

COORDINATES FOR COMET P/D'ARREST

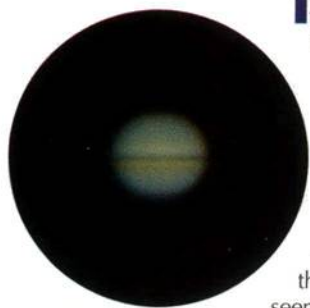
Date	R.A. (2000) Dec.	Mag.
July 1	22h04.0m +8°23'	12.7
July 7	22h21.3m +7°01'	12.5
July 13	22h38.9m +5°05'	12.3
July 19	22h56.9m +2°32'	12.2
July 25	23h14.0m -0°36'	12.1
July 31	23h30.8m -4°17'	12.0

Comets always have the last laugh. The really bright ones, those that streak in close to the Sun and are catapulted into deep space, sneak up on us out of the blue. Periodic comets, those whose appearance we can predict, tend to be relatively faint. Still, we can observe these fuzzballs with small telescopes and track their motion relative to the starry realm that lies behind them.

You'll need a 6-inch or larger scope to follow Comet d'Arrest's motion in July through the

constellations Pegasus, Pisces, and Aquarius. Discovered in 1851, Comet d'Arrest swings sunward once every 6½ years. This time around, the comet will reach its closest point to the Sun on July 27, when it will glow rather faintly at magnitude 12. The comet's brightness varies considerably depending on where the comet is relative to Earth and the Sun, so that in some passages it is nearly visible to the naked eye. This time you'll need to use your scope and carefully follow the comet's motion using the finder chart above.

THE RINGED PLANET APPEARS RINGLESS



Charles Capen

It seems everyone who has viewed Saturn through a telescope has the same reaction: "It looks just like its picture!" Who knows how many backyard astronomers fell in love with the hobby with their first look at the ringed planet? And it seems nearly every one of

them revels in showing Saturn to beginners with hopes that they, too, will get hooked.

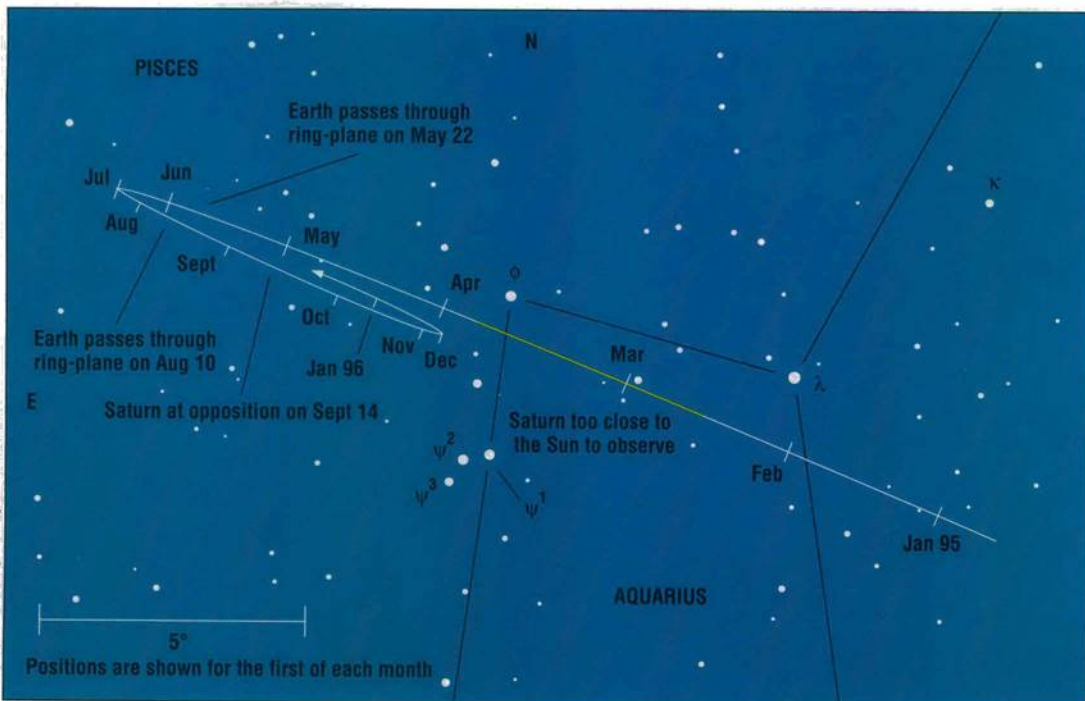
But 1995 isn't the year to excite first-timers with Saturn's magnificent rings. For the months between May and August, only the globe of the planet appears. And for most of the rest of the year, the rings will appear razor-thin — certainly not the familiar, beloved view. This is a year for seasoned observers to enjoy Saturn as it rarely appears and to concentrate on the planet itself instead of the rings.

It's been 15 years since Saturn's rings appeared edge-on as seen from Earth. Twice during each of Saturn's 29.4-year-long orbits, Earth passes through the plane of Saturn's rings. Because the rings are so thin — less than a mile thick compared with 170,000 miles wide — people observing at these times can't even tell that the rings exist.

Your first view of the impending action comes in late March, when Saturn becomes visible in the east before sunrise. By mid-April, the rings tilt less than 2° to our line of sight. The first milestone of the year comes on May 22, when Earth passes through the ring-plane heading from north to south. Over the next month or so, the rings open up slightly, but remain invisible. That's because Earth is then south of the ring-plane but the Sun remains north, so no light hits the rings on the side facing us.

That changes on August 10, when Earth moves back through the ring-plane heading north. Within a week or so the rings become visible again, though by the time of the planet's opposition in mid-September, they still appear only as a narrow streak. But they disappear again in mid-November when the Sun passes through the ring-plane heading north to south, so that the rings once again are lit from the side facing away from Earth. The planet's appearance won't return to normal until 1996, after Earth passes through the ring-plane for the last time until 2009.

April 12, 1995 Disk size = 15.8" Magnitude = 1.2	August 10, 1995 Disk size = 18.8" Magnitude = 0.9
May 22, 1995 Disk size = 16.6" Magnitude = 1.3	September 19, 1995 Disk size = 19.2" Magnitude = 0.7
July 1, 1995 Disk size = 17.7" Magnitude = 1.1	October 29, 1995 Disk size = 18.6" Magnitude = 0.8



Astronomy: Both diagrams by Phil Kirchmeier

August

S	M	T	W	T	F	S
		1	2	3	4	5
6	7	8	9	10	11	12
13	14	15	16	17	18	19
20	21	22	23	24	25	26
27	28	29	30	31		

Day Time (EDT)

- 11 a.m.**
The Moon passes 2° south of Mars
- 6 p.m.**
Jupiter is stationary
- 4 p.m.**
The Moon passes 2° north of Jupiter
- noon**
Mercury passes 1.1° north of Regulus (evening)
- 5 p.m.**
Earth passes through the ring-plane of Saturn
- midnight**
Pluto is stationary
- Perseid meteors peak (Full Moon)
- 7 a.m.**
The Moon passes 5° north of Saturn
- 8 p.m.**
Venus is in superior conjunction
- 11 a.m.**
Asteroid Pallas is in conjunction with the Sun
- 9 p.m.**
Asteroid Vesta is in conjunction with the Sun
- 9 a.m.**
Mars passes 2° north of Spica (evening)
- 3 a.m.**
The Moon passes 1.8° south of Mercury
- midnight**
The Moon passes 0.2° south of Mars

Events in **bold** are highlights you won't want to miss.

S	M	T	W	T	F	S
					1	●
3	4	5	6	7	○	9
10	11	12	13	14	15	○
17	18	19	20	21	22	23
●	25	26	27	28	29	30

Day Time (EDT)

2 midnight

The Moon passes
3° north of Jupiter

5 7 a.m.

The Moon passes
5° north of Neptune

3 p.m.

The Moon
passes 6° north of
Uranus

9 midnight

**Mercury reaches
greatest eastern
elongation (27°,
evening)**

14 11 a.m.

**Saturn is at
opposition**

20 3 a.m.

Jupiter passes
5° north of Antares
(evening)

22 2 a.m.

Mercury is stationary

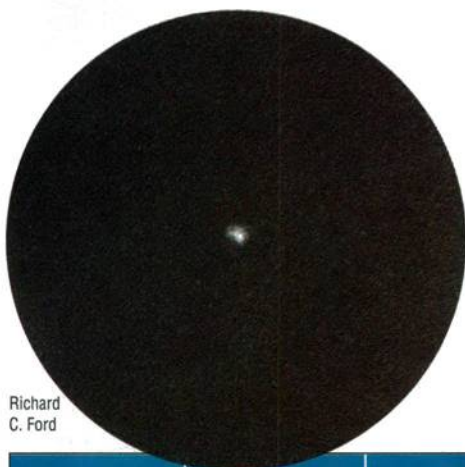
23 8 a.m.

Equinox (northern
autumn/southern
spring begins)

Events in **bold** are
highlights you won't
want to miss.

WITNESS MERCURY'S EVENING SHOW

Elusive Mercury puts on a great evening performance this year for Northern Hemisphere viewers in August and September, when the orange-hued world creeps above the western horizon shortly after sunset. To see Mercury, head outside around dusk in early August and look due west. The planet will be the brightest "star" visible in that area of sky. Yet Mercury's glow, immersed with the soft shades of twilight, can be tricky for the eye to pinpoint. Take along a pair of binoculars to slowly scan the western horizon. This may help with finding the planet initially, and you can then pick it up with the eye alone.

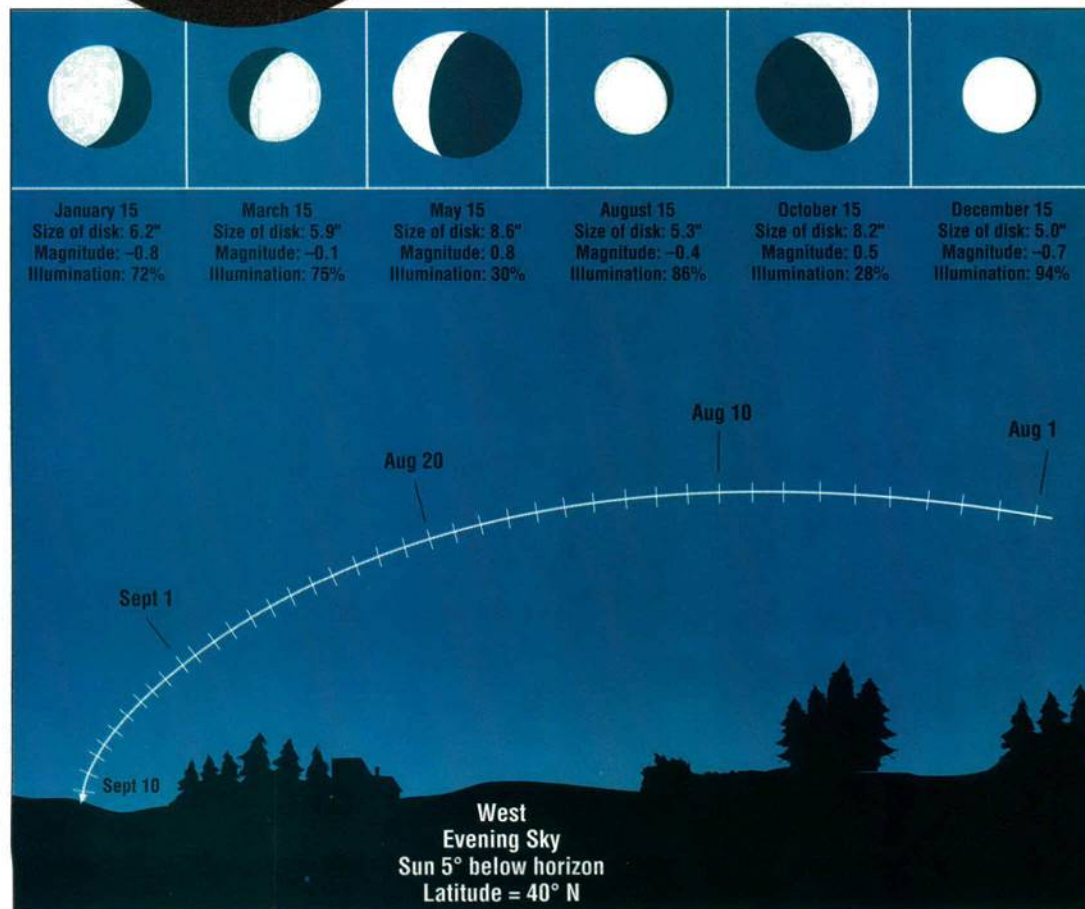


Richard
C. Ford

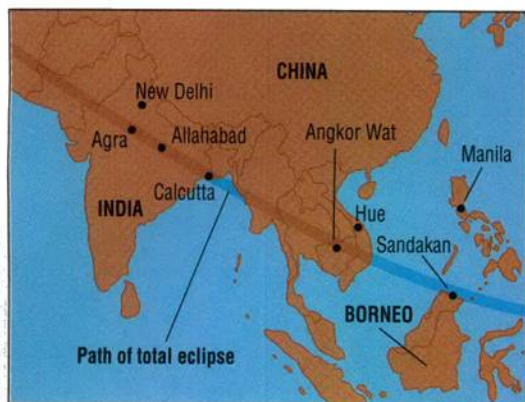
From the same spot facing west each evening at the same time throughout August and September, Mercury's changing position appears as a smooth, flat arc. Throughout August the planet is relatively high after sunset; after mid-September it becomes harder to see. Should you succeed in following Mercury's appearance, try looking at the planet's disk with a telescope. It will go from a mostly lit gibbous phase to a fat crescent during the initial weeks of autumn.

WHEN TO SEE MERCURY IN 1995

EVENING		
Greatest elongations	Visible from	Max. angle from Sun
Jan. 19	Jan. 1 to Jan. 29	19°
May 11	Apr. 22 to May 26	22°
Sept. 9	Aug. 6 to Sept. 29	18°
MORNING		
Greatest elongations	Visible from	Max. angle from Sun
Mar. 1	Feb. 10 to Apr. 6	27°
June 29	June 15 to July 20	22°
Oct. 20	Oct. 12 to Nov. 8	18°



A TOTAL ECLIPSE FOR SOUTHERN ASIA



ASTRONOMY: Phil Kirchmeier

The Moon passes in front of the Sun for the second time this year on October 24. But whereas the Moon was relatively far from Earth in April when observers in parts of South America got to see an annular solar eclipse, this time the Moon is significantly closer. The result: a total solar eclipse for viewers who trek to southern Asia.

The eclipse begins as the Sun rises in Iran, some 50 miles due south of Tehran, where totality lasts just 16 seconds as the Sun pokes above the eastern horizon. The Moon's shadow then heads southeast across Iran, Afghanistan, Pakistan, and India, where Calcutta gets to see the Sun disappear for about a minute. The track then continues across Southeast Asia before heading into the South China Sea. Maximum eclipse takes place slightly north of the island of Borneo, where the Sun disappears for 2 minutes 10 seconds.

Few major cities lie in the path of totality because the path is so narrow, reaching a maximum diameter of just 50 miles. However the eclipse track does pass over the 12th-century ruins at Angkor Wat in Cambodia, which should make a fascinating vista for viewing the eclipse.

Eclipse chasers can expect the best weather prospects near the India-Pakistan border, where on October mornings the skies over the Great Indian Desert are clear 90 percent of the time. The Calcutta area also looks promising, with clear skies occurring 60 to 70 percent of the time. Prospects deteriorate as you head farther east, with only about a 30 to 40 percent chance of clear weather in Southeast Asia and the South China Sea.

OCTOBER 24 TOTAL SOLAR ECLIPSE

Cities within path of totality	Time (UT) of maximum eclipse	Length of totality	Sun's altitude
Agra, India	3h05m	0m49s	27°
Allahabad, India	3h10m	0m33s	31°
Angkor Wat, Cambodia	4h00m	1m46s	62°
Calcutta, India	3h20m	0m52s	40°
Sandakan, Malaysia	4h50m	1m11s	67°

PLANETS CONGREGATE IN THE EVENING SKY

As October begins, the western sky after sunset starts to come alive with planets. Mars, which has been in the evening sky since February, has been sinking slowly into the twilight glow for the past few months. Jupiter, in the evening sky since June, appears brighter than Mars and is higher in the sky but sinks into the twilight more rapidly. Thus the gap between these two worlds shrinks noticeably.

These two are joined in early October by a third planet, the brightest of them all, Venus. Venus is climbing out of the twilight glare, however, to meet the other two planets. You can easily see the three lined up in the southwest during the last half of October, with Venus the lowest, Jupiter highest, and Mars in between. But the best view will come on the evening of October 25, when a slender crescent Moon lies halfway between Venus and Mars (below). A pretty scene also awaits you on the following two nights, as the waxing Moon passes Mars and then Jupiter.

Don't stop watching the twilight sky after October ends. Jupiter continues sinking and Venus continues rising while Mars pretty much stays put relative to the horizon. The three come together during the third week of November, when they all lie within 2° of one another and form the most spectacular grouping of planets to be seen all year.



ASTRONOMY: Phil Kirchmeier

PLANET CONJUNCTIONS IN 1995

Jan. 14 Venus 3° north of Jupiter (morning)	Sep. 28 Mercury 5° south of Venus (evening)
Mar. 2 Venus 1.5° north of Uranus (morning)	Nov. 16 Mars 1.2° south of Jupiter (evening)
Mar. 25 Mercury 0.6° south of Saturn (morning)	Nov. 19 Venus 1.3° south of Jupiter (evening)
Apr. 13 Venus 0.6° north of Saturn (morning)	Nov. 22 Venus 0.2° south of Mars (evening)
Jun. 19 Mercury 4° south of Venus (morning)	Dec. 23 Mercury 1.1° south of Mars (evening)

October

S	M	T	W	T	F	S
●	2	3	4	5	6	7
○	9	10	11	12	13	14
15	●	17	18	19	20	21
22	23	●	25	26	27	28
29	●	31				

Day Time (EDT, before Oct. 29)

- 4 a.m.**
Venus passes 3° north of Spica (evening)
9 p.m.
Mercury is in inferior conjunction
- 6 p.m.**
The Moon passes 6° north of Saturn
- 9 p.m.**
Asteroid Ceres is in conjunction with the Sun
- 13 5 a.m.**
Mercury is stationary
- 20 10 a.m.**
Mercury reaches greatest western elongation (18°, best morning appearance for northern latitudes)
- 22 Orionid meteors peak (waning crescent Moon)**
6 p.m.
The Moon passes 4° south of Mercury
- 24 1 a.m.**
Total solar eclipse (Asia)
- 25 7 a.m.**
The Moon passes 1.9° north of Venus
- 26 7 a.m.**
The Moon passes 4° north of Mars
- 27 2 a.m.**
The Moon passes 4° north of Jupiter
- 29 2 a.m.**
Daylight saving time ends
- 30 8 a.m.**
Mercury passes 4° north of Spica (morning)

Events in **bold** are highlights you won't want to miss.

November

S	M	T	W	T	F	S
			1	2	3	4
5	6	7	8	9	10	11
12	13	14	15	16	17	18
19	20	21	22	23	24	25
26	27	28	29	30		

Day Time (EST)

- 2 7 a.m.**
Mars passes 4° north of Antares
- 9 p.m.**
The Moon passes 6° north of Saturn
- 3** Southern Taurid meteors peak (waxing gibbous Moon)
- 10 1 p.m.**
Venus passes 4° north of Antares
- 13** Northern Taurid meteors peak (waning gibbous Moon)
- 16 3 a.m.**
Mars passes 1.2° south of Jupiter
- 17** Leonid meteors peak (Last Quarter Moon)
- 19 7 a.m.**
Venus passes 1.3° south of Jupiter
- 22 9 a.m.**
Saturn is stationary
- 5 p.m.**
Venus passes 0.2° south of Mars
- 23 midnight**
Mercury is in superior conjunction (behind the Sun)
- 2 a.m.**
Pluto is in conjunction with the Sun (behind the Sun)
- 26 2 a.m.**
The Moon passes 5° north of Neptune
- 9 a.m.**
The Moon passes 6° north of Uranus
- 30 2 a.m.**
The Moon passes 6° north of Saturn

Events in **bold** are highlights you won't want to miss.

A BINOCULAR HOP IN ANDROMEDA

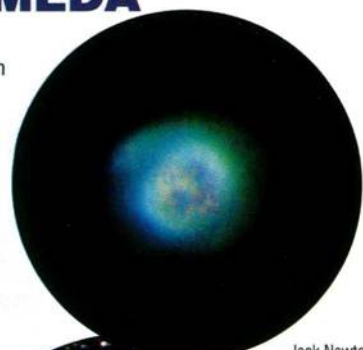
Autumn offers the perfect opportunity to take a step beyond the solar system into the realm of deep space. The backbone of the summer Milky Way rolls out of the evening sky, offering a chance to peer beyond to galaxies as well as to view star clusters and nebulae in our home Galaxy. To survey some of the most alluring deep-sky objects of the autumn sky, you need simply a pair of binoculars or a telescope of 3- or 4-inch aperture.

The best place to start is the Andromeda Galaxy (M31), the closest spiral to the Milky Way. This slender fuzz stands out to the eye alone under a dark sky but appears best in binoculars. Other objects lie scattered in a circle around M31. Working clockwise, find the galaxies M33 in Triangulum and M74 in Pisces, more challenging than their nearby cousin. Also find star clusters NGC 752 in Andromeda and the brilliant Pleiades in Taurus, a binocular treat. The elusive California Nebula (NGC 1499) will be visible only on the darkest nights.

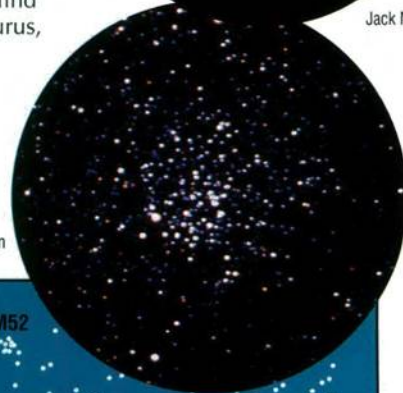
The region of Cassiopeia holds many star clusters, including the Double Cluster, which is a naked-eye fuzz, and NGC 457, M52, and NGC 7789. Continue your clockwise trip to find planetary nebula NGC 7662 back in Andromeda, the expanding remains of a dying star.



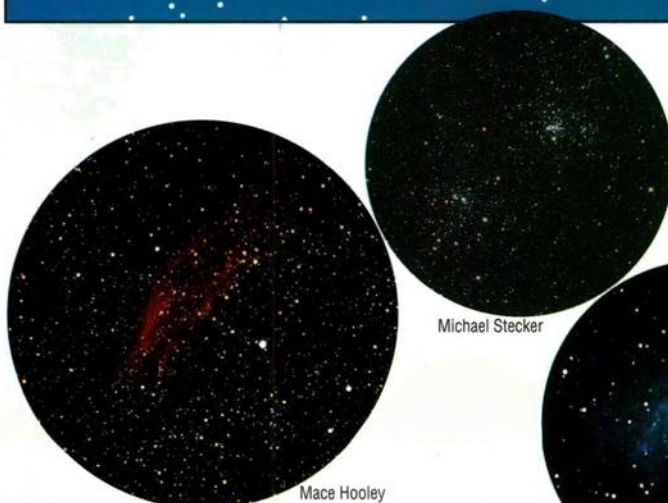
ASTRONOMY: Lee Vande Visse



Jack Newton



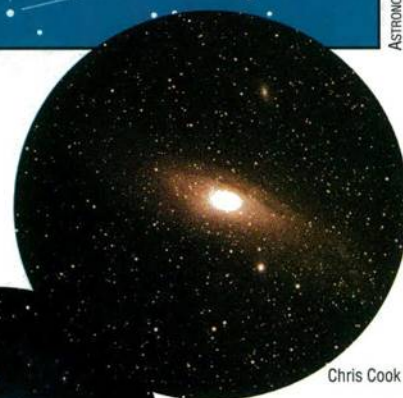
Scott Rosen



Mace Hooley



Michael Stecker

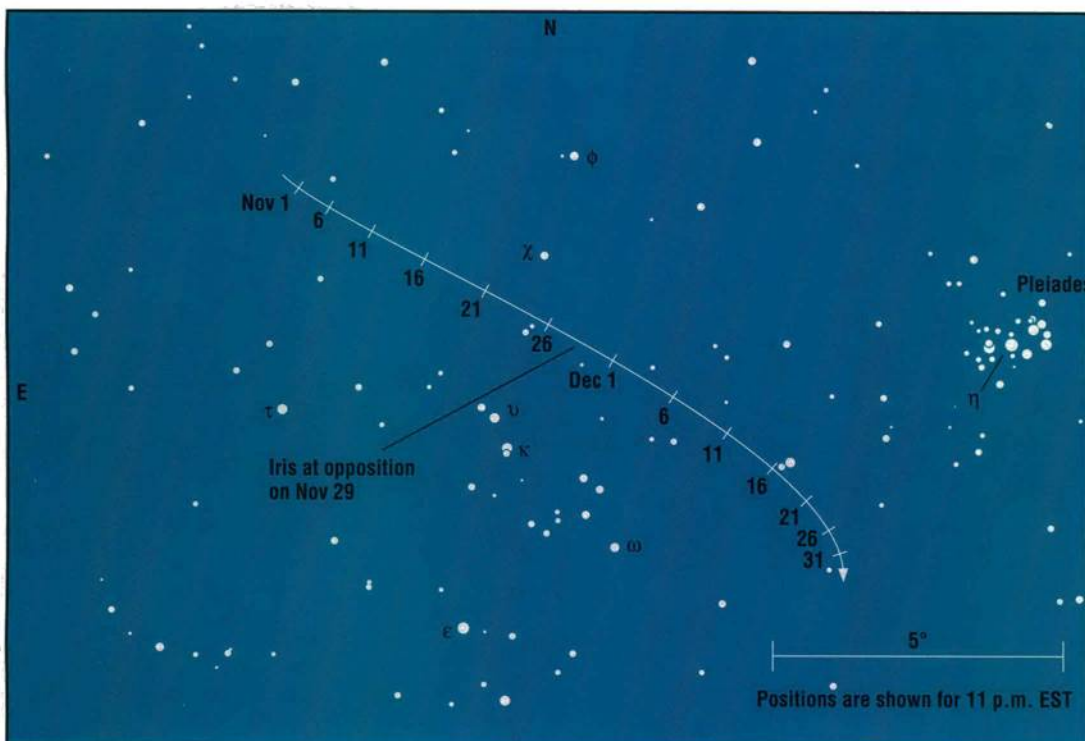


Chris Cook



Scott Rosen

A LATE-AUTUMN ASTEROID



Literally thousands of rocky chunks too small to be called planets circle the Sun. Ranging in size from 600 miles to a small fraction of a mile across, most of these minor planets, or asteroids, are too small to reflect much sunlight back toward Earth. Only one, named Vesta, ever gets bright enough to be seen with the naked eye, and only a handful can ever be spotted easily with binoculars. That's why when a good one comes along, you shouldn't pass up the chance to see it.

And the skies of November and December bring an especially good one: a 7th-magnitude asteroid named Iris. Iris can be found in Taurus, passing between the prominent Pleiades and Hyades star clusters. The 130-mile-wide object is at its brightest when it reaches opposition on November 29, but it remains brighter than magnitude 8.0 throughout November and December. This is as bright as Iris ever gets, just missing naked-eye visibility.

To locate Iris with binoculars or a telescope, use the finder chart or table of coordinates above. If you scan the area and can't pick out which point of light is Iris, don't despair. Sketch the field of view of your binoculars or telescope. Then a night or two later, return to the same region and observe it again. The point of light that appears out of place has moved because of its motion around the Sun: It is Iris.

ASTEROID IRIS COORDINATES

Date	R.A. (2000)	Dec.	Mag.
Nov. 1	4h41.1m	26°48'	7.6
Nov. 6	4h38.8m	26°27'	7.5
Nov. 11	4h35.5m	26°02'	7.3
Nov. 16	4h31.6m	25°33'	7.2
Nov. 21	4h27.1m	25°00'	7.0
Nov. 26	4h22.3m	24°24'	6.8
Dec. 1	4h17.6m	23°47'	6.8
Dec. 6	4h13.0m	23°08'	7.0
Dec. 11	4h09.0m	22°31'	7.2
Dec. 16	4h05.6m	21°55'	7.4
Dec. 21	4h02.9m	21°22'	7.6
Dec. 26	4h01.2m	20°53'	7.8
Dec. 31	4h00.5m	20°28'	7.9

Positions are shown for 11 p.m. EST (10 p.m. CST, 9 p.m. MST, and 8 p.m. PST)

GALILEO ARRIVES AT JUPITER

Although Jupiter is lost in the Sun's glare during most of December, it will be one of the big stories of the month. That's because the Galileo spacecraft, after a roundabout six-year journey that sent it past Venus once, Earth twice, and the asteroids Gaspra and Ida, reaches the giant planet on December 7. Expect the sophisticated spacecraft to beam back thousands of great pictures of Jupiter and its satellites in the months and years ahead.

December

S	M	T	W	T	F	S
					1	2
3	4	5	6	7	8	9
10	11	12	13	14	15	16
17	18	19	20	21	22	23
24	25	26	27	28	29	30
31						

Day Time (EST)

- 14** Geminid meteors peak (waning gibbous Moon)
- 16** noon
Venus passes 2° south of Neptune (evening)
- 18** 5 p.m.
Jupiter is in conjunction with the Sun
- 20** 8 a.m.
Venus passes 1.3° south of Uranus (evening)
- 22** 3 a.m.
Solstice (northern winter/southern summer begins)
- 23** 2 a.m.
The Moon passes 7° north of Mercury
2 a.m.
The Moon passes 6° north of Mars
4 a.m.
Mercury passes 1.1° south of Mars (evening)
- 24** 5 a.m.
The Moon passes 7° north of Venus
- 27** 10 a.m.
The Moon passes 5° north of Saturn
9 p.m.
Mercury passes 2° south of Neptune (evening)

Events in **bold** are highlights you won't want to miss.

THE STARS OF SPRING

On spring evenings, the Big Dipper in the constellation Ursa Major lies high overhead. A line drawn through the two stars in the pouring edge of the Dipper's bowl and extended north points to Polaris, the North Star. If you extend a line from the Dipper's Pointer stars in the direction away from Polaris, you come to Leo the Lion and its bright star Regulus. (This spring you'll also see Mars in this region.) Follow the arc of the Dipper's handle and you come to Arcturus in Bootes. Continue the arc south and you'll find Spica in Virgo.

SKY SHOWN FOR March 1 at 1 a.m., March 15 at midnight, April 1 at 11 p.m., April 15 at 11 p.m. DST, May 1 at 10 p.m. DST. Latitude = 40° north.



ASTRONOMY: Steven G. Davis

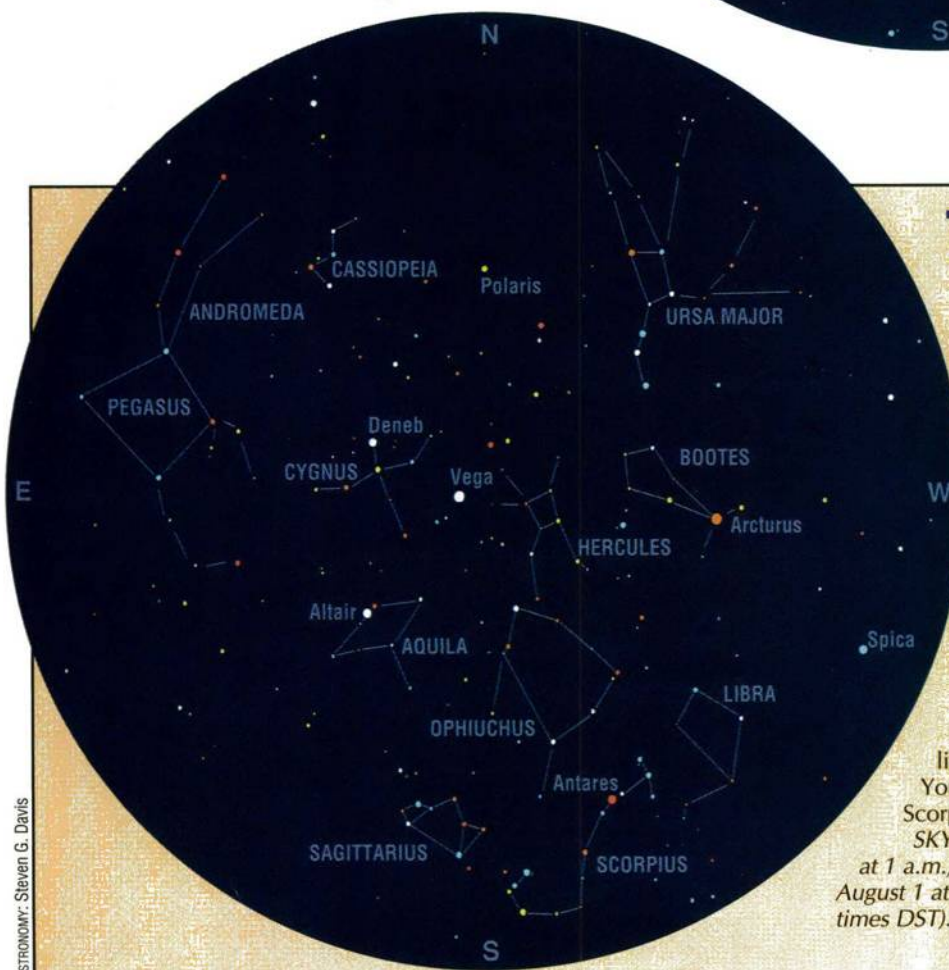
THE STARS OF SUMMER

Overhead a trio of bright stars forms a pattern called the Summer Triangle. Farthest west is the brightest of the three — Vega in the constellation Lyra, the Harp. To the east is Deneb, the tail of Cygnus, the Swan, a pattern also known as the Northern Cross. The southern corner of the Summer Triangle is Altair, the bright eye of Aquila, the Eagle.

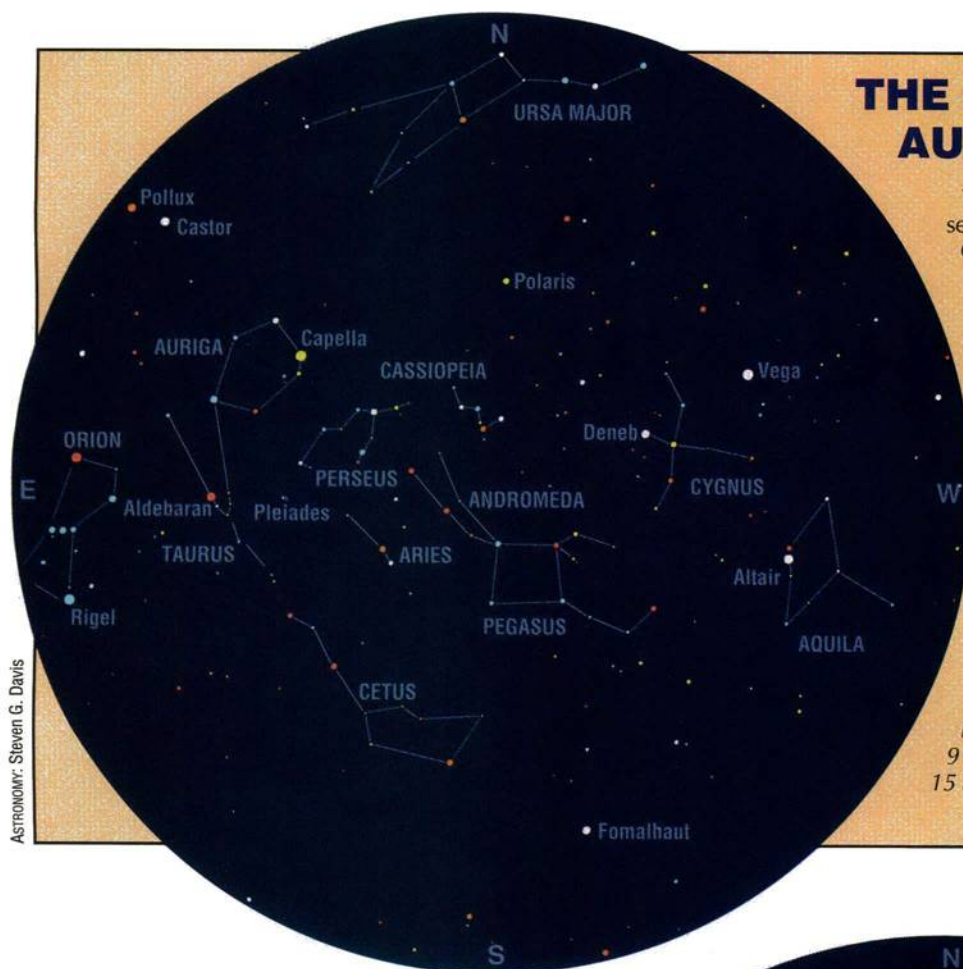
Along the southern horizon look for a bright reddish star. That's Antares, the heart of Scorpius, the Scorpion. Just to the east is Sagittarius, the Archer, whose brightest stars resemble a teapot. But the brightest point of light in this year's summer sky is Jupiter.

You can find this planet between the stars of Scorpius and Ophiuchus, the Serpent-Bearer.

SKY SHOWN FOR June 1 at 2 a.m., June 15 at 1 a.m., July 1 at midnight, July 15 at 11 p.m., August 1 at 10 p.m. DST, August 15 at 9 p.m. (all times DST). Latitude = 40° north.



ASTRONOMY: Steven G. Davis



THE STARS OF AUTUMN

The "W" pattern of stars overhead represents the constellation Cassiopeia, the Queen. Below Cassiopeia toward the southern horizon lies a square of four bright stars. The Great Square marks the body of Pegasus, the Flying Horse. An arc of three stars extends from the northeast corner of Pegasus. It distinguishes Andromeda, the daughter of Cassiopeia, who was rescued by Perseus, the Hero. Perseus also inhabits this region, east of Andromeda and south of Cassiopeia. This autumn you'll find Saturn, the famed Ringed Planet, shining brightly about halfway between Pegasus and the bright star Fomalhaut near the southern horizon.

SKY SHOWN FOR: October 1 at 1 a.m. DST, October 15 at midnight DST, November 1 at 10 p.m., November 15 at 9 p.m., December 1 at 8 p.m., December 15 at 8 p.m. Latitude = 40° north.

THE STARS OF WINTER

The keystone of the winter evening sky is the constellation Orion, the Hunter. Look for a distinctive pattern of three stars in a row in the south. This is Orion's belt. A straight line drawn through the belt and extended up brings you to Aldebaran, the reddish eye of Taurus, the Bull. Extend the line down from the belt and you come to Canis Major and the star Sirius, the brightest star in the night sky.

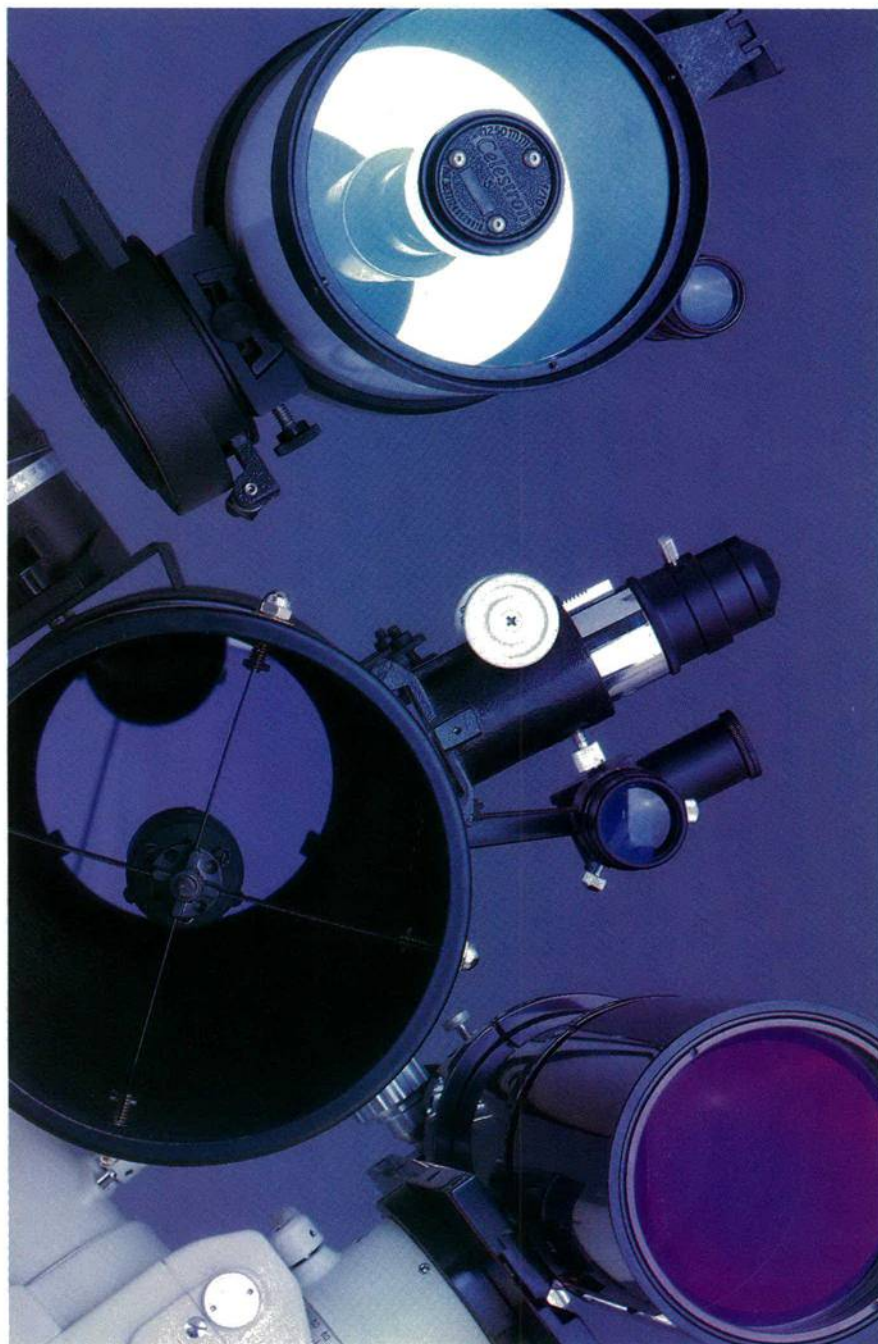
During the first few months of 1995, you'll see an additional bright "star" among the background stars of Leo and its eastern neighbor, Cancer. This ruddy light is the Red Planet, Mars, which at opposition in mid-February rivals Sirius as the brightest object in the night sky.

SKY SHOWN FOR January 1 at 11 p.m., January 15 at 10 p.m., February 1 at 9 p.m., February 15 at 8 p.m., March 1 at 7 p.m. Latitude = 40° north.



Shopping for a Telescope

Here's your shopping center for telescopes, with information and prices on over 300 models and advice on selecting the right one.



Scientists have invented some fantastic instruments for exploring nature. One device can collect photons of energy emitted millions of light-years away and focus them into real-time images of objects far fainter than the human eye alone can detect. Sound like NASA's latest orbiting observatory, or that multibillion dollar particle detector you've been reading about?

No. It's a telescope. Any telescope. For the price of a not-too-fancy VCR or a deluxe Nintendo game, you can own an instrument that will show you the wonders of the universe. Live. Right from your own backyard.

The View Through a Telescope

The Moon is by far the most dramatic target for any new telescope. An alien landscape fills your eyepiece field with the same stark craters and mountains the Apollo astronauts skimmed over 25 years ago. Even a small telescope working at 100 power can show you the Moon as it would appear from a spaceship orbiting a few thousand miles above the lunar surface. Each night the view changes as sunlight creeps across the Moon to reveal new moonscapes emerging from the deep lunar shadows.

The planets, being much farther away, reveal their features only under careful examination. At 100 to 150 power Jupiter shows itself as a flattened globe crossed by several dark cloud bands. With a trained eye, you can begin to pick out changes in the Jovian cloud structures from week to week, even night to night. In some years, Jupiter's famous Red Spot storm shows up as a pale pink oval in the southern hemisphere. And as an added attraction Jupiter's four large moons shuttle back and forth from one side of Jupiter to the other, changing positions noticeably even within a few minutes.

Mars is an elusive world, seen at its best only every two years. For a few weeks during its biennial close approaches to Earth, Mars appears as a small reddish world in the eyepieces of telescopes around the world. Amateurs everywhere scan the Martian globe, following the changing polar caps and subtle dark markings that were once thought to be fields of vegetation blooming in the deserts of Mars. Venus, with its perpetual cover of cloud, shows only its changing phases through Earthbound telescopes.

But Saturn more than makes up for the elusiveness of Mars and the featureless disk of Venus. If there were no object in the sky other than Saturn, it would still be worth owning a telescope.

Even at low power, its rings are plainly visible encircling a yellow-hued globe. No backyard astronomer ever tires of looking at Saturn.

The Moon and planets are celestial sights you can see from any location, even from the confines of a brightly lit city. For the sky's other attractions, it does help to observe as far from the glare of city lights and the haze of air pollution as you can.

Beyond the solar system lies the domain of deep-sky astronomy. From dark sky locations, amateur stargazers delight in tracking down a selection of the hundreds of star clusters, nebulae, and galaxies within reach of even small telescopes. Larger telescopes reveal more distinct views of these always faint targets. In 6- to 8-inch-aperture telescopes, for example, globular star clusters begin to resolve into spheres of uncountable stars, and galaxies reveal wispy spiral arms and elusive dust lanes.

When shopping for a telescope, you really need to be concerned with only a few key points of comparison. By far the most important telescope specification is aperture.

Aperture

When amateurs speak of a "3-inch refractor" or a "6-inch reflector" they are referring to the scope's aperture — the diameter of the main lens or mirror that collects the light. The larger the aperture, the more light the telescope can collect and focus into an image. The brighter the image, the more detail you'll be able to see, especially in faint objects such as nebulae and galaxies.

Doubling the aperture of a telescope makes a big difference in how bright objects will look. You might think a 6-inch telescope, for example, would yield images twice as bright as a 3-inch would, but not so. A 6-inch mirror has four times the area of a 3-inch, so it produces images four times as bright.

In general, backyard telescopes with apertures from 2.4 to 5 inches are classed as "small" telescopes. Moderate-aperture scopes range from 6 to 10 inches, while large-aperture scopes start at 12 inches and go up from there. You can even buy monster telescopes with mirrors three feet across.

Focal Length

Sometimes given in inches, sometimes in millimeters (as with camera lenses), a telescope's focal length is the length of the light path measured from where the incoming light first hits the main lens or mirror to where it finally reaches a focus.

With many telescopes the focal length is about the same as the physical length of the tube. But some telescopes fold the light path back and forth several

times inside the tube. This lets the telescope be much shorter than its focal length would imply.

A telescope of short focal length (500 to 750mm) is usually best for low-power scanning of wide areas of the sky. Observers who want to specialize in high-power views of the planets often opt for telescopes with long focal lengths (1,500 to 3,000mm). But don't follow these guidelines too rigorously. A well-made telescope of any focal length can provide fine views of all types of celestial objects over a wide range of magnifications. In fact, in the accompanying tables of telescope specs we haven't even listed focal length. It's something you can figure out, however, by noting the next telescope spec, its "f/ratio."

F/ratio

Take the focal length of the telescope and divide it by the aperture and you get

the telescope's focal ratio, or f/ratio. A telescope with an f/ratio of f/4 has a focal length four times the diameter of the main lens or mirror. This might be a 4-inch scope with a focal length of 16 inches. It might also be a 16-inch scope with a focal length of 64 inches. Both are f/4s. (Conversely, you can multiply the aperture times the f/ratio to get the telescope's focal length.)

Telescopes with f/ratios of f/4 to f/6 are called "fast" optical systems. They are usually considered best suited for low-power deep-sky observing. "Slow" systems, ones with f/ratios of f/12 to f/15, have long focal lengths and are therefore often said to be best for high-power planetary viewing. But again, take these classic rules with a grain of salt. An f/4 scope with good optics can yield sharp views of the planets, while an f/15 telescope equipped with a suitable low-power eyepiece can provide terrific

Buying for a Child

Despite the hundreds of models on the market today, parents looking for a quality telescope to encourage the interest of a child have a tough choice. What is available, especially for the \$200 to \$300 budget of many parents?

First, here's what to avoid: Any telescope advertised solely on the basis of its magnification, no matter how tempting the price. Of these "High-Power 500x" models (most of them 50mm and 60mm refractors), some are plastic toys that won't stand up to typical use. Others have plastic lenses that will fail to give sharp images. Many have mounts and tripods so shaky the image wobbles all over the field of view. All come with eyepieces that provide too much power and dim finderscopes that are difficult to look through.

A 60mm refractor on an altazimuth mount can be a rugged, easy-to-use starter scope, but look for these features:

- ✓ All tube and mount parts made of metal or wood, not plastic.
- ✓ A main lens made of coated glass, not plastic.
- ✓ Eyepieces with focal lengths no shorter than 9mm providing powers no higher than 100x to 150x.
- ✓ Eyepieces with the more popular 1.25-inch diameter barrels (as opposed to 0.965 inches).
- ✓ Slow-motion controls on both axes of the mount. They help you keep objects centered in the field.
- ✓ A finderscope with six adjustment screws, not three. This arrangement makes the finder much easier to align with the main optics.
- ✓ A 6x30 finderscope. The 30mm aperture lens makes it easier to locate objects.

You may not find all these features in one model, but expect to pay \$250 to \$300 for a unit that contains most of these traits.

A preferred alternative in the \$300 price range, a 6- or 8-inch reflector on a Dobsonian mount, will provide far superior image quality and still be easy to set up and use, even for a young child. Be prepared to spend a bit more for optional finderscopes, extra eyepieces, and shipping, bringing the total bill up to \$400 or so.

If \$200 is your absolute limit, we suggest buying a pair of 7x50 or 10x50 binoculars. Together with an introductory book and a basic star atlas, the package needn't cost more than \$150. Spend a year helping your child learn the constellations and explore the sky with this "beginner's kit." If your young astronomer's interest remains strong at the end of the year, then consider a good-quality telescope such as an 80mm or 90mm refractor or a 4- to 8-inch reflector (all in the \$400 to \$600 range), instruments that can sustain a lifelong interest.

views of large deep-sky objects. In most cases, however, fast telescopes will be shorter and more portable. On the other hand, you'll often find better image quality in slower telescopes.

Resolving Power

To look their best, telescopic images need to be not just bright but sharp. How well telescopes can resolve fine detail also depends on aperture. A 6-inch scope can resolve detail twice as fine as

a 3-inch can. The resolving power of a 12-inch scope doubles yet again.

Resolving power is often given in seconds of arc. A rule-of-thumb calculation is that the resolving power of a well-made telescope equals 4.5 arcseconds divided by the aperture in inches. Thus, a 4.5-inch scope can resolve stars that are 1 second of arc apart, a very tiny angle. A pair of stars closer together than that will look like a single point of light. Train a 12.5-inch scope on this

pair, however, and chances are its 0.36-arcsecond resolving power will split these stars apart. Large scopes will also reveal finer detail on the Moon and planets.

When manufacturers state a certain value for the resolving power of a telescope, they're usually just stating what any telescope of that aperture is theoretically capable of providing. They are not stating a measured performance spec for that particular model.

Achromatic Refractors

Manufacturer	Model	Aperture (in.)	F/ratio	Mount design	Drive	Slow motion	Setting circles	Finder	Focuser size (in.)	Average selling price
2.4-inch (60mm) Altazimuth Refractors										
Celestron	Firstscope 60	2.4	13.3	Altazimuth	—	✓	—	5x24	.965	\$139
Celestron	C60	2.4	13.3	Altazimuth	—	✓	—	5x20	.965	\$169
Meade	#227	2.4	11.7	Altazimuth	—	✓	—	5x24	1.25	\$199
Tasco	#302058	2.4	11.6	Altazimuth	—	✓	—	5x24	.965	\$229
Orion	TeleVista II	2.4	11.6	Altazimuth	—	✓	—	5x24	1.25	\$239
Orion	Observer	2.4	11.6	Altazimuth	—	✓	—	5x24	.965	
Parks	PRT-1	2.4	11.6	Altazimuth	—	—	—	5x24	1.25	\$299
Simmons	#6340	2.4	11.6	Altazimuth	—	✓	—	5x24	.965	\$300
Parks	Wide-Field 60	2.4	7.6	—	—	—	—	6x30	1.25	\$350
Parks	PRT-2	2.4	11.6	Altazimuth	—	✓	—	10x	1.25	\$399
Swift	#863	2.4	13.3	Altazimuth	—	✓	—	6x24	.965	\$450
Unitron	#105	2.0	14	Altazimuth	—	✓	—	6x24	1.25	\$645
Unitron	#114	2.4	15	Altazimuth	—	✓	—	6x24	1.25	\$880
2.4-inch (60mm) Equatorial Refractors										
Celestron	C60E	2.4	13.3	German equatorial	—	✓	✓	5x20	.965	\$279
Meade	#285	2.4	15	German equatorial	opt.	✓	✓	6x30	1.25	\$319
Tasco	#302851	2.4	15	German equatorial	—	✓	✓	5x24	.965	\$321
Simmons	#6440	2.4	15	German equatorial	—	✓	✓	5x24	.965	\$340
Orion	Sky Explorer 60 II	2.4	15	German equatorial	opt.	✓	✓	6x30	1.25	\$399
Edmund	#S31-611	2.4	8	Equatorial fork	—	—	—	5x24	1.25	\$419
Parks	PRT-46	2.4	15.1	German equatorial	opt.	✓	✓	10x	1.25	\$499
Swift	#859R	2.4	15	German equatorial	opt.	✓	✓	6x30	.965	\$730
Unitron	#128	2.4	15	German equatorial	AC	✓	✓	6x24	1.25	\$1,125
Zeiss	Telemator	2.4	13.3	German equatorial	AC	✓	✓	7.5x42	.965	\$1,350
3-inch (80mm to 90mm) Altazimuth Refractors										
Meade	#390	3.6	11	Altazimuth	—	✓	—	6x30	1.25	\$499
Celestron	Firstscope 80	3.1	11.4	Altazimuth	—	✓	—	6x30	1.25	\$579
Unitron	#140	3.0	16	Altazimuth	—	✓	—	6x24	1.25	\$1,250
Sky Instr.	Omcon 128SE	3.1	12.5	Altazimuth	—	—	—	6x30	1.25	n/a
3-inch (80mm to 90mm) Equatorial Refractors										
Photon	PIC80LC	3.1	15	German equatorial	—	✓	✓	6x30	1.25	\$498
Orion	Sky Explorer 80 II	3.1	15	German equatorial	opt.	✓	✓	6x30	1.25	\$577
Meade	#395	3.6	11	German equatorial	opt.	✓	✓	6x30	1.25	\$599
Parks	PRT-813	3.1	11.2	German equatorial	opt.	✓	✓	6x30	1.25	\$599
Fraunhofer	3.1" Doublet	3.1	15	German equatorial	AC	✓	✓	6x30	1.25	\$930
Photon	PIC80	3.1	15	German equatorial	DC	✓	✓	6x30	1.25	\$1,250
Photon	PIC80F	3.1	15	German equatorial	DC	✓	✓	6x30	1.25	\$1,500
Unitron	#142	3	16	German equatorial	AC	✓	✓	8x30	1.25	\$1,950
Sky Instr.	Omcon 128D	3.1	12.5	German equatorial	opt.	✓	✓	6x30	1.25	n/a
Sky Instr.	Omcon 119D	3.6	10.8	German equatorial	opt.	✓	✓	6x30	1.25	n/a
4-inch and Larger Refractors										
Celestron	GP-C102	4	9.8	German equatorial	opt.	✓	✓	6x30	1.25	\$1,279
Photon	PIC100	4	15	German equatorial	DC	✓	✓	7x50	1.25	\$2,250
Unitron	#150	4	15	Altazimuth	—	✓	—	10x42	1.25	\$2,875
Unitron	#152	4	15	German equatorial	AC	—	✓	10x42	1.25	\$3,700
Sky Instr.	Omcon 1211T	4.1	12.4	German equatorial	opt.	✓	✓	6x30	2	n/a
D & G	5" Achromat	5	12	opt.	—	—	—	8x50	2.7	\$1,295
D & G	6" Achromat	6	12	opt.	—	—	—	8x50	2.7	\$1,595
Fraunhofer	6" Doublet	6	15	opt.	—	—	—	8x50	2	\$3,000
Optical Guid.	10" Achromat	10	10	opt.	—	—	—	8x50	2	\$12,750

Also available: 8" and 10" achromatic refractors from D & G Optical; 5" and 6" achromatic refractors and 3" to 6" achromats with folded optics from Photon Instruments.

Telescopes listed in order of increasing aperture. Telescopes of same or similar aperture listed in order of increasing price. Prices are typical selling prices at full-service dealers; prices may vary from dealer to dealer. n/a = data not available; opt. = optional.

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See the Meade ad in this magazine for full specifications and product descriptions. ED = Extremely low dispersion glass which yields color-free virtually perfect images. PPEC = Permanent Periodic Error Correction "Smart Drive."

Model 102 ED 4" f/9 Apochromat & mount (add \$105 P&S) \$2495
Model 127 ED 5" f/9 Apochromat & mount (add \$125 P&S) \$2995
Model 152 ED 6" f/9 Apochromat & mount (add \$185 P&S) \$4495
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Medium format adapters . . . Mamiya 645, \$98; Pentax 6X7, \$98
Med. format EASY-GUIDER™: Mamiya 645, \$298; Pentax 6X7, \$298
Medium format EASY-GUIDER for Hasselblad . . . \$495

DRIVE SYSTEMS

#1697 Computer Drive, 747 object computer memory, automatic slewing to desired object . . . \$695
8,000 Object CNGC Library . . . \$99 Polar alignment finder . . . \$99

OPTICAL TUBE ASSEMBLIES (OTA)

Model 102 ED/OTA 4" f/9 OTA only (add \$55 P&S) . . . \$1045
Model 127 ED/OTA 5" f/9 OTA only (add \$60 P&S) . . . \$1595
Model 152 ED/OTA 6" f/9 OTA only (add \$100 P&S) . . . \$2295
Model 178 ED/OTA 7" f/9 OTA only (add \$120 P&S) . . . \$3250
Cradle ring assem. 4" (4 1/2" OD tube) \$135; 5" (5 1/2" OD tube) \$145
Cradle ring assem. 6" (7" OD tube) \$169; 7" (8" OD tube) \$219

EQUATORIAL MOUNTS

LXD 650 mount and standard field tripod (add \$60 P&S) . . . \$1495
LXD 750 mount and giant field tripod (add \$100 P&S) . . . \$2475

NOTE: Add the indicated packing and shipping (P&S) costs to each telescope for insured UPS shipment to your door.

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Drop shipped from Meade, add shipping charge in parenthesis.

6" f/8 Starfinder Dobsonian (\$39) . . . \$295
8" f/6 Starfinder Dobsonian (\$49) . . . \$395
10" f/4.5 Starfinder Dobsonian (\$69) . . . \$585
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16" f/4.5 Starfinder Dobsonian (\$45) . . . \$1295*

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8" LX200
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NEW! 12" LX200 (f/10 only) with computer (add \$215 P&S) . . . \$3995
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Meade 2080B 8" f/10 with tripod, wedge, MCOG (add \$85 P&S) . . . \$1149
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PHOTOGRAPHY ACCESSORIES

LUMICON Cassegrain EASY-GUIDER 4", 8" only, f/6 or f/10 . . . \$249
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*All Starfinder telescopes shipped directly from Meade to the purchaser. Please add the indicated shipping charge to the price. LUMICON showroom prices are \$99 higher.

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LUMICON carries the full line of Meade accessories. See the Meade ad in this magazine for detailed prices and descriptions.

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LUMICON DX200 Dual-axis drive cor. . . \$249
Meade 47M Dual-axis drive corrector . . . \$475
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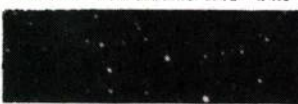
Specify Telescope Type: Meade 2045, 2080, 2120, C-8, C-11, Odyssey 8, 10, 13, 17 1/2, Alt-Azimuth.

Ultima 8, 11 . . . add \$25, C-14 . . . add \$75

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Protect the optics of your 8-14" Schmidt-Cassegrain with a UV/Dust Seal. Simply thread it onto the rear cell, then attach all normal accessories. The large size fits Meade 2120, Celestron-11 and -14 & has a high quality multi coated (removable) 72mm UV filter.
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UV/Dust Seal (large) for Meade 2120 . . . \$89.50
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Low profile star diagonal eyepiece holder \$16.00
Meade 2" Diagonal/Giant Easy-Guide \$39.50
*Threaded to hold 48mm filters.

Limiting Magnitude

One way of specifying the light-gathering power of a telescope is to state how faint a star that telescope can show. The larger the aperture of the scope, the fainter a star it can show. Star brightnesses are given in "magnitudes" — a 1st-magnitude star is among the brightest in the sky, a 6th-magnitude star is about the faintest you can see with the unaided eye. A 12th-magnitude star is within easy reach of a 4-inch telescope, while a 12.5-inch scope can reveal stars as faint as 15th magnitude. Again, as with resolving power, when manufacturers give limiting-magnitude figures in their literature, they are usually just stating the

accepted figures for any telescope of that aperture.

Wavefront Error

Some telescope and optics manufacturers promise their mirrors are "guaranteed to 1/8-wave" or some such number. This usually means that the accuracy of the mirror's surface deviates from the ideal surface by no more than 1/8th of a wavelength of light. Sometimes this number is given as the total wavefront error of the complete telescope, taking into account the accumulated errors introduced by all the optical surfaces involved. As a general rule, a total wavefront error of 1/4-wave is considered very

good and 1/6-wave superb. By definition, a pledge that a telescope is "diffraction limited" means it has a wavefront error of no worse than 1/4 wave and will resolve stars as close as theory says it should.

Maximum Power

What about magnification? Sellers of junky "toy" telescopes often bill them as "500-power" marvels, leading the inexperienced buyer to believe magnification is the prime measure of quality and performance.

In fact, just the opposite is true. A good rule is to avoid any telescope advertised strictly by how much power it

Apochromatic Refractors

Manufacturer	Model	Aperture (in.)	F/ratio	Lens design	Mount design	Drive	Finder	Focuser size (in.)	Average selling price
Small Refractors									
Tele Vue	Pronto	2.8	6.8	Doublet ED Apo	opt.	—	opt.	2	\$850
Zeiss	AS 80/840	3.1	10.5	Doublet Semi-Apo	opt.	—	7.5x42	2	\$1,500
Takahashi	FC-60SB	2.4	8.3	Doublet Fluorite Apo	German equatorial	DC	5x25	1.34	\$2,195
Takahashi	FC-76ES	3	7.9	Doublet Fluorite Apo	German equatorial	DC	7x50	2	\$2,575
Takahashi	FC-76H	3	7.9	Doublet Fluorite Apo	German equatorial	DC	7x50	2	\$3,275
4-inch Refractors									
Tele Vue	Genesis	4	5	4-el. Fluorite Apo	opt.	—	opt.	2	\$1,650
Tele Vue	Genesis SDF	4	5.4	4-el. SD+Fluorite Apo	opt.	—	opt.	2	\$1,950
Meade	102ED Apo	4	9	Doublet ED Apo	German equatorial	opt.	8x50	2	\$2,195
Tele Vue	Renaissance SDF	4	5.4	4-el. SD+Fluorite Apo	opt.	—	opt.	2	\$2,250
Zeiss	AS 100/1000	4	10	Doublet Semi-Apo	opt.	—	7.5x42	2.7	\$2,300
Celestron	GP-C102F	4	8.8	Doublet Fluorite Apo	German equatorial	opt.	6x30	1.25	\$2,399
Zeiss	APQ 100/1000	4	10	Triplet Fluorite Apo	opt.	—	7.5x42	2.7	\$3,600
Astro-Physics	105 Traveler EDT	4.1	5.8	Triplet ED Apo	German equatorial	DC	opt.	2.7	\$3,623
Zeiss	APQ 100/640	4	6.4	Triplet Fluorite Apo	opt.	—	7.5x42	2.7	\$3,900
Takahashi	FC-100H	4	8	Doublet Fluorite Apo	German equatorial	DC	7x50	2.7	\$4,895
Takahashi	FC-100NH	4	10	Doublet Fluorite Apo	German equatorial	DC	7x50	2.4	\$4,895
Takahashi	FC-100SE	4	8	Doublet Fluorite Apo	German equatorial	DC	7x50	2.7	\$5,995
Takahashi	FC-100N	4	10	Doublet Fluorite Apo	German equatorial	DC	7x50	2.4	\$5,995
5-inch Refractors									
D & G	5.1" Apochromat	5.1	9.5	Doublet ED Apo	opt.	—	8x50	2.7	\$1,995
Meade	127ED Apo	5	9	Doublet ED Apo	German equatorial	opt.	8x50	2	\$2,795
Astro-Physics	130 Starfire EDT	5.1	8	Triplet ED Apo	German equatorial	DC	opt.	2.7	\$4,641
Astro-Physics	130 Starfire EDFS	5.1	6	Triplet ED Apo	German equatorial	DC	opt.	2.7	\$4,941
Zeiss	APQ 130/1000	5	7.7	Triplet Fluorite Apo	opt.	—	7.5x42	2.7	\$6,500
Takahashi	FC-125SE	5	8	Doublet Fluorite Apo	German equatorial	DC	7x50	2.7	\$9,295
Takahashi	FC-125NJP	5	8	Doublet Fluorite Apo	German equatorial	DC	7x50	2.7	\$12,795
6-inch Refractors									
Meade	152ED Apo	6	9	Doublet ED Apo	German equatorial	opt.	8x50	2	\$4,495
Astro-Physics	155 Starfire EDT	6.1	9	Triplet ED Apo	German equatorial	DC	opt.	2.7	\$6,701
Astro-Physics	155 Starfire EDFS	6.1	7.1	Triplet ED Apo	German equatorial	DC	opt.	2.7	\$7,661
Astro-Physics	155 Starfire EDF	6.1	7.1	Triplet ED Apo	German equatorial	DC	opt.	4	\$9,999
Zeiss	APQ 150/1200	6	8	Triplet Fluorite Apo	opt.	—	7.5x42	2.7	\$10,000
Takahashi	FCT-150	6	7	Triplet Fluorite Apo	German equatorial	DC	11x70	4	\$31,927
Takahashi	FC-150	6	11.3	Doublet Fluorite Apo	German equatorial	DC	7x50	4	\$32,505
Large Refractors									
Meade	178ED Apo	7	9	Doublet ED Apo	German equatorial	opt.	8x50	2	\$5,495
Astro-Physics	180 Starfire EDT	7.1	9	Triplet ED Apo	German equatorial	DC	opt.	2.7	\$8,777
Zeiss	APQ 200/1600	8	8	Triplet Fluorite Apo	opt.	—	opt.	4	\$15,000
Solar Telescopes									
Tele Vue	Solaris	2.4	30	5-element Refractor	opt.	—	—	2	\$2,700
Questar	Questar 3.5 Solar	3.5	14.4	Maksutov-Cassegrain	Equatorial fork	DC	6x	1.25	\$6,875

NOTE: All telescopes on this list that include mounts also have manual or electric slow-motion controls and setting circles.

Telescopes listed in order of increasing aperture. Telescopes of same or similar aperture listed in order of increasing price. Prices are typical selling prices at full-service dealers; prices may vary from dealer to dealer. n/a = data not available; opt. = optional.

provides. An ad that proclaims "Professional 500x Model" is a sure sign that the telescope in question is best bypassed.

The maximum power any telescope can usefully provide is about 50 power per inch of aperture. Beyond this limit, the light collected by the telescope is spread out over too large an area, yielding nothing but dim, blurry images.

But not to worry. You don't need 500 power to explore the universe. A top power of 120x to 200x is just fine for planets and other small targets requiring high power. A quality telescope from a reputable supplier, even a low-priced model, will be advertised with realistic magnifications and with the aperture of the telescope, not its power, as the main specification.

Lenses, Mirrors, and Cats

If you are new to astronomy, chances are you find the many telescope designs more than a little confusing. You might be thinking, "If I buy the wrong type of telescope I'll be sentenced to a lifetime of poor views." Relax. There are no "wrong" telescopes. There are different designs, but each is capable of providing sharp, clear images of all types of objects.

Refractors

Telescopes that use lenses to gather and focus light are called refractors. These are the classic "spyglass" style of instruments. Refractors are most popular and economical in small apertures — from 2.4 inches to 4 inches. Larger refractors are available but are quite expensive per inch of aperture. The most affordable refractors use achromatic lenses made of two separate lenses that work together to yield images relatively free of chromatic aberration, an optical flaw that produces purple haloes around bright objects. This aberration becomes more noticeable in bigger refractors.

To completely eliminate the false color, you can turn to one of the new generation of apochromatic refractors. These instruments use exotic fluorite or extra-low dispersion (called ED) glasses in two-, three-, or four-element lenses. The result is unsurpassed optical quality but at a premium price.

Refractors traditionally deliver sharp, contrasty images with pinpoint stars and crisp views of the Moon and planets. Refractors are also known for their rugged simplicity; they need little maintenance, and their lenses rarely need alignment. They are also easy to aim.



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These traits make a small refractor a popular choice for young astronomers.

Reflectors

Telescopes that use mirrors are called reflectors. The most common variety, the Newtonian reflector, uses a concave



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main mirror at the bottom of the tube, which focuses the light back up to the top of the tube. There, a small flat mirror called a diagonal deflects the light at right angles to an eyepiece on the side of the tube. The fact that you don't look in the same direction the telescope points makes using a Newtonian reflector confusing at first for beginners. In addition, the exposed mirrors can collect dust and grime and occasionally need adjustment

to keep them properly aligned, or collimated.

But Newtonian reflectors are the best bargains in the telescope world, offering the most aperture for the money. A 6-inch reflector can cost the same as — or even less than — a 3-inch refractor and provide enough aperture to reveal hundreds of deep-sky objects, as well as show wonderful detail on the Moon and planets. Many observers feel that the

minor maintenance required is a small price to pay for the extra performance for the dollar.

Catadioptrics

Six-inch f/5 to f/8 Newtonians have tubes three to four feet long, still quite portable. Larger-aperture Newtonians, however, with tubes six feet or longer can become rather unwieldy and awkward to cart around. An alternative is

Dobsonian & Altazimuth Reflectors

Manufacturer	Model	Aperture (in.)	F/ratio	Secondary mirror size (in.)	Finder	Setting circles	Focuser size (in.)	Tube length (in.)	Total weight (lbs.)	Tube style	Average selling price
Small Altazimuth Newtonians											
Steve Dodson	3" Altazimuth	3	n/a	n/a	✓	—	1.25	n/a	7	Solid	\$189
Eurolit	CR 2.6 Cosmotron	2.6	7.7	n/a	—	—	1.25	20	20	Solid	\$320
Edmund	Astroscan 2001	4.2	4.2	1.50	—	—	1.25	17	13	Solid	\$340
Compact Dobsonian Reflectors (6- to 10-inch)											
Meade	Starfinder Dob.	6	8	1.18	opt.	—	1.25	48	44	Solid	\$295
Orion	Deep Space Explorer	6	8	1.20	opt.	—	1.25	48	29	Solid	\$299
Coultier	Odyssey 8 f/7	8	7	1.83	opt.	—	1.25	57	59	Solid	\$240
Coultier	Odyssey 8	8	4.5	2.14	opt.	—	1.25	36	39	Solid	\$275
Meade	Starfinder Dob.	8	6	1.52	opt.	—	1.25	48	n/a	Solid	\$395
Orion	Deep Space Explorer	8	6	1.52	opt.	—	1.25	48	39	Solid	\$399
Z Optical	Z-Scope	8	6	1.83	Telrad	opt.	1.25	52	51	Solid	\$795
Coultier	Odyssey Compact	10.1	4.5	2.60	opt.	—	1.25	46	65	Solid	\$345
Meade	Starfinder Dob.	10	4.5	2.37	opt.	—	1.25	45	61	Solid	\$565
Orion	Deep Space Explorer	10	5.6	2.14	opt.	—	1.25	56	68	Solid	\$599
Z Optical	Z-Scope	10	5	2.60	Telrad	opt.	1.25	53	65	Solid	\$995
Mid-sized Dobsonian Reflectors (12- to 15-inch)											
Meade	Starfinder Dob.	12.5	4.8	3.10	opt.	—	1.25	60	97	Solid	\$765
Orion	Deep Space Explorer	12.5	4.8	3.10	opt.	—	1.25	60	85	Solid	\$769
Cusick	Starhunter 1	12.5	4.8	n/a	Telrad	—	2	n/a	80	Truss	\$1,199
Torus	12.5" Dob.	12.5	5.6	2.14	Telrad	—	2	72	60	Truss	\$2,095
MAG 1	PortaBall 1	12.5	4.8	2.60	Telrad	—	2	65	69	Truss	\$2,395
Starsplitter	Starsplitter II	12.5	4.8	2.60	Telrad	—	2	63	80	Truss	\$2,495
Coultier	Odyssey 1	13.1	4.5	3.10	opt.	—	1.25	58	100	Solid	\$575
Sky Designs	14.5" VPT	14.5	4.5	3.10	—	—	2	65	88	Truss	\$2,150
Tectron	15" Dob.	15	5	2.14	Telrad	—	2	75	100	Truss	\$2,400
Obsession	Obsession 15	15	4.5	2.60	—	opt.	2	58	65	Truss	\$2,695
Torus	14.5" Dob.	14.5	5.5	2.14	Telrad	—	2	76	85	Truss	\$2,695
Starsplitter	Starsplitter II	14.5	5.2	2.60	Telrad	—	2	74	95	Truss	\$2,795
Large Dobsonian Reflectors (16- to 20-inch)											
Meade	Starfinder Dob.	16	4.5	4.00	opt.	—	1.25	68	150	Solid	\$1,195
Starsplitter	Starsplitter II	16	4.7	3.10	Telrad	—	2	76	105	Truss	\$3,195
Torus	16" Dob.	16	5.5	2.60	Telrad	—	2	78	100	Truss	\$3,195
Sunrise	16" Dob.	16	5	2.60	Telrad	opt.	2	n/a	107	Truss	\$3,290
Coultier	Odyssey 2	17.5	4.5	4.25	opt.	—	1.25	76	206	Solid	\$1,150
Sky Designs	18" VPT	18	4.5	3.50	—	—	2	77	110	Truss	\$2,750
Safari	Safari 18	18	4.5	3.10	—	—	2	70	148	Truss	\$3,100
Starsplitter	Starsplitter II	18	4.5	3.10	Telrad	—	2	81	115	Truss	\$3,495
Sunrise	18" Dob.	18	5	3.10	Telrad	opt.	2	n/a	129	Truss	\$3,495
Torus	18" Dob.	18	5	2.60	Telrad	—	2	91	120	Truss	\$3,795
Obsession	Obsession 18	18	4.5	3.10	—	opt.	2	72	95	Truss	\$3,895
Sunrise	20" Dob.	20	5	3.10	Telrad	opt.	2	n/a	149	Truss	\$3,695
Tectron	20" Dob.	20	5	2.60	Telrad	—	2	100	150	Truss	\$3,700
Sky Designs	20" VPT	20	4	4.00	—	—	2	78	150	Truss	\$3,850
Starsplitter	Starsplitter II	20	5	3.10	Telrad	—	2	98	170	Truss	\$3,995
Torus	20" Dob.	20	5	3.10	Telrad	—	2	102	150	Truss	\$4,295
Obsession	Obsession 20	20	5	3.10	—	opt.	2	94	130	Truss	\$4,495
Giant Dobsonian Reflectors (22- to 36-inch)											
Starsplitter	Starsplitter II	22	4.5	3.50	Telrad	—	2	98	220	Truss	\$5,995
Tectron	25" Dob.	25	5	3.50	Telrad	—	2	125	250	Truss	\$7,500
Starsplitter	Starsplitter II	25	5	4.00	Telrad	—	2	126	260	Truss	\$8,095
Torus	24" Dob.	24	5	3.50	Telrad	—	2	115	240	Truss	\$8,595
Obsession	Obsession 25	25	5	3.50	—	opt.	2	115	220	Truss	\$8,895
Sky Designs	24" VPT	24	4	n/a	—	—	2	n/a	n/a	Truss	n/a

Also available: Obsession 30 (\$11,995), and Obsession 36 (\$13,995); Starsplitter 30 (\$9,995); Tectron 30 (\$10,000).

Telescopes listed in order of increasing aperture. Telescopes of same or similar aperture listed in order of increasing price. n/a = data not available; opt. = optional.

another type of reflector called the catadioptric. This hybrid telescope uses a mirror as the light-collecting element but also employs a lenslike corrector plate at the front to eliminate certain types of image-blurring aberrations. The light path is folded within the tube, packing a fairly long focal length into a stubby tube.

By far the most popular telescope of this type is the Schmidt-Cassegrain. Eight-inch Schmidt-Cassegrains boast tubes only 16 inches long yet have focal lengths of 50 to 80 inches, with all the advantages of a generous 8-inch aperture.

Another catadioptric design, the Maksutov, uses a different style of corrector lens but offers the same compact convenience coupled with high-performance optics. However, all "cats" are more expensive per inch of aperture than most Newtonian reflectors, the tradeoff for the added portability.

Dobs and Forks

The optics are really only one-half of the telescope. Just as important is what the optical tube is mounted on. Similar optical tube assemblies (the same 3-inch refractor or 6-inch reflector, for example) are sometimes offered on different styles of mountings, from the simple to the complex and computerized.

No matter how long its list of features, the most important function of any mount is to move the telescope smoothly around the sky and to hold the optics steady once you find your target. If the mount shakes, you'll be fighting to see detail in a jittery image that bounces around the eyepiece with every touch to the focuser or every breath of wind.

Most telescopes sold to serious backyard astronomers come on well-designed mounts. The shaky mounts with tall spindly legs are found mainly on the same "Professional 500x" models you should avoid because of their fuzzy, over-powered optics.

However, there are different styles of mountings to match different pocket-books.

Altazimuth mounts

Found mostly on 2.4- to 3-inch refractors, this mounting has two simple motions — up-down (altitude) and side-to-side (azimuth). For ease of use, look for models with slow-motion controls on both axes. These allow you to fine-tune the position of the telescope, handy for locating objects and necessary for tracking targets. At 50x to 150x, you'll be surprised at how fast objects drift out of the field due to the rotation of the Earth. You'll need to keep recentering objects, and good slow-motion



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controls help you do that smoothly and with minimal vibration. The continual recentering is a bit of a nuisance but on the other hand altaz mounts are economical and easy to set up.

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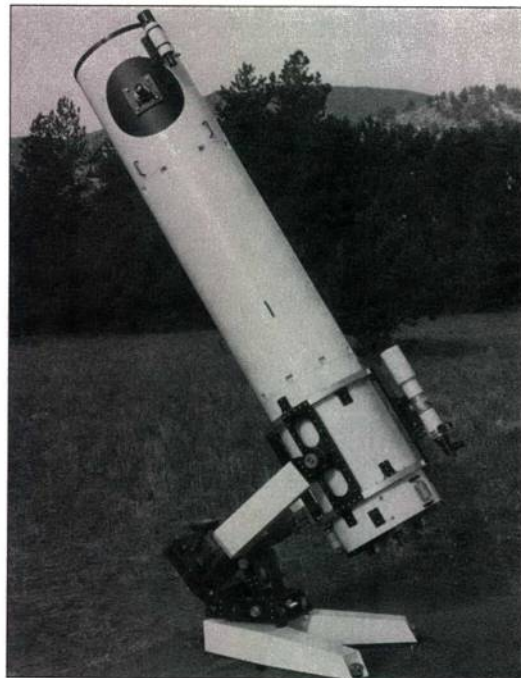
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Dobsonian mounts

This type of altazimuth mounting is the wooden box style you see on many Newtonian reflectors, especially large ones. It is compact, steady, quick to set up, and attractively priced. While there are no slow-motion controls on a Dobsonian, the axes move so smoothly it is

easy to nudge the scope by tiny amounts to keep objects centered.

The simplicity of a "Dob" coupled with the inherent value of Newtonian optics makes large 12- to 20-inch reflectors not only practical, but relatively affordable. Smaller Dobsonian-mounted reflectors in the 6- to 10-inch size are

unsurpassed values in today's telescope market.

German equatorial mounts

Neither altazimuth nor Dobsonian mounts will automatically track the stars. Equatorial mounts, on the other hand, can follow celestial objects with one

Equatorial Reflectors

Manufacturer	Model	Aperture (in.)	F/ratio	Secondary mirror size (in.)	Mount design	Drive	Slow motion	Setting circles	Finder	Focuser size (in.)	Average selling price
Small Newtonians (3- to 5-inch)											
Edmund	#S31-308	3	6	n/a	Equatorial fork	—	—	—	—	1.25	\$219
Meade	#4500	4.5	8	1.13	German equatorial	—	✓	✓	6x30	1.25	\$399
Orion	SpaceProbe 4.5	4.5	7.9	1.06	German equatorial	opt.	✓	✓	6x30	1.25	\$399
Europtik	CR 4.5 Cosmotron	4.5	7.3	n/a	German equatorial	opt.	✓	✓	6x30	1.25	\$450
Celestron	C4.5	4.5	7.9	1.06	German equatorial	opt.	✓	✓	6x30	1.25	\$579
Simmons	#6450	4.5	7.2	1.25	German equatorial	—	✓	✓	5x24	.965	\$600
Tasco	#302012	4.5	7.9	1.06	German equatorial	opt.	✓	✓	5x24	.965	\$688
Swift	#853	4.5	7.9	1.06	German equatorial	opt.	✓	✓	5x24	.965	\$698
Sky Instr.	Omcon 811D	4.5	8	1.06	German equatorial	opt.	✓	✓	6x30	1.25	n/a
6-inch Newtonians											
Cosmos	6" Newtonian	6	8	1.25	opt.	—	—	—	opt.	1.25	\$395
Cosmos	6" Newtonian	6	6	1.50	opt.	—	—	—	opt.	2	\$419
Iowa Scientific	NWT-608	6	8	1.25	German equatorial	opt.	✓	opt.	6x30	1.25	\$575
Iowa Scientific	NWT-605	6	5	1.50	German equatorial	opt.	✓	opt.	6x30	1.25	\$585
Meade	Starfinder Eq.	6	8	1.18	German equatorial	AC	—	✓	6x30	1.25	\$599
Iowa Scientific	PNT-612	6	12	0.75	German equatorial	opt.	✓	opt.	6x30	1.25	\$775
Parks	Precision	6	8	1.33	German equatorial	opt.	opt.	opt.	6x30	1.25	\$799
Parks	Precision	6	6	1.55	German equatorial	opt.	opt.	opt.	6x30	1.25	\$799
Parallax	PI 150 High-Res.	6	9	1.00	opt.	—	—	—	8x50	1.25	\$845
Europtik	CR 6 Cosmotron	6	n/a	n/a	German equatorial	opt.	✓	✓	6x30	1.25	\$995
Parks	Astrolight	6	8	1.33	German equatorial	opt.	✓	✓	6x30	1.25	\$999
Parks	Astrolight	6	6	1.55	German equatorial	opt.	✓	✓	6x30	1.25	\$999
Star Liner	Econoline	6	8	n/a	German equatorial	AC	—	✓	6x30	1.25	\$1,400
Star Liner	Quality	6	8	n/a	German equatorial	AC	✓	✓	6x30	1.25	\$2,700
Sky Instr.	Omcon 715T	6	6.7	n/a	German equatorial	opt.	✓	✓	8x50	2	n/a
8-inch Newtonians											
Cosmos	8" Newtonian	8	6	1.83	opt.	—	—	—	opt.	2	\$619
Iowa Scientific	NWT-806	8	6	1.50	German equatorial	opt.	✓	opt.	6x30	2	\$685
Meade	Starfinder Eq.	8	6	1.52	German equatorial	AC	—	✓	6x30	1.25	\$699
Parks	Precision	8	6	1.83	German equatorial	opt.	opt.	opt.	6x30	1.25	\$1,199
Celestron	GP-C200	7.9	4	2.40	German equatorial	opt.	✓	✓	6x30	2	\$1,499
Star Liner	Econoline	8	7	n/a	German equatorial	AC	—	✓	6x30	1.25	\$1,590
Parallax	PI 200 High-Res.	8	7.5	1.50	opt.	—	—	—	8x50	2	\$1,695
Parks	Superior	8	6	1.83	German equatorial	DC	✓	✓	8x50	2	\$2,499
Star Liner	Quality	8	7	n/a	German equatorial	AC	✓	✓	6x30	1.25	\$3,200
Sky Instr.	Omcon 520T	8	5	n/a	German equatorial	opt.	✓	✓	8x50	2	n/a
ASKO/RVR	SX-210	8.25	6.7	n/a	German equatorial	DC	✓	✓	8x50	2	n/a
10-inch Newtonians											
Meade	Starfinder Eq.	10	4.5	2.37	German equatorial	AC	—	✓	6x30	1.25	\$799
Parallax	PI 250 High-Res.	10	6.5	1.83	opt.	—	—	—	8x50	2	\$2,095
Star Liner	Quality	10	6	n/a	Equatorial fork	AC	✓	✓	10x50	2	\$2,150
Parks	Superior	10	5	2.60	German equatorial	DC	✓	✓	8x50	2	\$2,899
Optical Guid.	10" Newtonian	10	5	3.50	German equatorial	DC	✓	✓	8x50	2.5	\$7,015
Large Portable Newtonians (12-inch and larger)											
Jupiter	Juno 12.5	12.5	4.5	2.60	Equatorial table	AC	opt.	opt.	Telrad	2	\$2,995
Parks	Superior	12.5	5	3.10	German equatorial	DC	✓	✓	8x50	2	\$3,999
JMI	NTT 12	12.5	5	4.00	Computerized altaz	DC	✓	✓	8x50	2	\$4,200
Meade	Starfinder Eq.	16	4.5	4.00	German equatorial	AC	—	✓	8x50	2	\$2,195
Jupiter	Juno 15	15	4.5	2.60	Equatorial table	AC	opt.	opt.	Telrad	2	\$3,895
Light Speed	Light Speed 16	16	6.2	2.60	Equatorial fork	DC	✓	✓	9x60	2	\$13,500
Jupiter	Juno 18	18	4.5	3.10	Equatorial table	AC	opt.	opt.	Telrad	2	\$5,295
JMI	NGT 18	18	4.5	4.00	Split-ring equatorial	DC	✓	✓	8x50	2	\$10,340
Light Speed	Light Speed 20	20	5	4.00	Equatorial fork	DC	✓	✓	11x80	2	\$15,500
JMI	NTT 25	25	5	9.00	Computerized altaz	DC	✓	✓	11x80	2	\$22,500

NOTE: See "Other Reflectors" table for more listings of large-aperture equatorial reflectors.

Telescopes listed in order of increasing aperture. Telescopes of same or similar aperture listed in order of increasing price. Prices are typical selling prices at full-service dealers; prices may vary from dealer to dealer. n/a = data not available; opt. = optional.

simple motion around the polar axis, which is pointed to the celestial pole. Couple a motor to that axis and celestial objects will stay nicely centered in the eyepiece as the telescope slowly turns on its own to follow the sky. This is a great convenience for studying objects at high power, and essential if you want to take astrophotos.

German equatorial mounts are the style usually employed on long-tube telescopes such as refractors and reflectors. They can be a little confusing at first for beginners (you really do need to read the instructions!) but they work well. Motor drives are sometimes included, sometimes offered as options.

Equatorial fork mounts

Stubby-tubed telescopes such as Schmidt-Cassegrains often come on fork mounts with built-in motor drives. Like the German equatorial, a fork mount needs to be set up so that the polar axis of the mount is aimed close to the celestial pole of the sky (near the North Star for Northern Hemisphere users). For casual visual observing, this polar alignment process is quite simple and quick. Polar alignment becomes more protracted only when you align accurately enough for long-exposure photography.

A new generation of fork-mounted telescopes doesn't need to be polar

aligned at all and yet can track the stars with their built-in motors. The secret is the computerized drive system that "knows" where the telescope is aimed and pulses the motors on the two axes in tandem to track objects across the sky.

Checking the Features List

After the optics and the mount, the difference between models of telescopes sometimes lies in the details. Here's a rundown on the most important features you should pay attention to:

Finderscope. Most telescopes include a small spotting scope on the side of the tube. This finderscope is much more important than you might think. Finding objects using only the main telescope, even at its lowest power is much too difficult — the field of view is too narrow. Most finderscopes, however, are only 6 or 8 power. Their crosshair eyepieces and wide view of the sky help you precisely aim the main telescope.

A 6x30 finderscope has a 6-power eyepiece and a 30mm-aperture lens, a good combination for small telescopes. Larger telescopes often feature 8x50 finderscopes. The larger lens allows you to see fainter stars and deep-sky objects, making it easier to sight targets in the



TELESCOPES WITH FOCUSERS

that accept 1.25-inch-diameter eyepieces (above) are a plus because they accommodate a variety of eyepieces. On the other hand, telescopes with 0.965-inch focusers are limited to a small selection of eyepieces.

finder. Many low-cost telescopes come with only 5x24 finders. Most of these provide faint images. Competitive telescopes with 6x30 finders have a decided advantage.

Eyepieces. The part you actually look through is the eyepiece. On all

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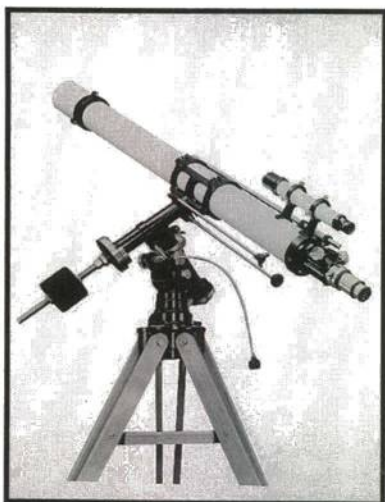
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astronomical telescopes, the eyepieces are interchangeable. To change magnifications, you switch eyepieces. Some telescopes come with a selection of three or four eyepieces. Others come with only one eyepiece and additional eyepieces must be purchased as optional accessories. While the former might seem a better buy, one good eyepiece is better than several of mediocre quality. The best eyepiece types usually included as standard equipment are the Kellner, Modified Achromat, Orthoscopic, and Plössl designs. Eyepieces often included with import telescopes

but best avoided are the Ramsden and Huygens varieties. These simple designs are hampered by narrow fields and image-blurring aberrations.

Finder. The eyepiece slips into a focuser that adjusts to bring the image into sharp focus. In entry-level telescopes, look for finders that accommodate eyepieces with 1.25-inch-diameter barrels. This is the most common size of eyepiece, with hundreds of high-quality models to pick from. Finders that take only the smaller 0.965-inch-diameter eyepieces limit

you to a small selection of eyepieces, some of substandard quality.

The finders on many premium telescopes accept 2-inch-barrel eyepieces as well as the smaller models. This allows you to add giant wide-angle eyepieces that require the larger diameter barrel.

Coatings. Some models of telescopes offer enhanced optical coatings as options. These increase light transmission through lenses and corrector plates and boost the reflectivity of mirrors. The result is brighter images that have more

Catadioptric Telescopes

Manufacturer	Model	Aperture (in.)	F/ratio	Secondary mirror size (in.)	Mount design	Drive	Speed controls?	Finder	Focuser size (in.)	Total weight (lbs.)	Average selling price
Small Schmidt-Cassegrains (3- to 5-inch)											
Swift	#854	3.1	12.5	n/a	Equatorial fork	—	—	4x20	1.25	9	\$1,050
Meade	#2045D	4	10	1.80	Equatorial fork	DC	—	5x24	1.25	13	\$699
Parks	Jovian-4	4	10	1.00	—	—	—	5x24	1.25	4	\$1,200
Swift	#856	4.5	8.7	n/a	German equatorial	opt.	—	6x30	.965	21	\$950
Celestron	C5	5	10	2.00	Equatorial fork	AC	—	5x24	1.25	23	\$979
Celestron	C5+	5	10	2.00	Equatorial fork	DC	✓	5x24	1.25	23	\$1,199
8-inch Schmidt-Cassegrains											
Celestron	Classic 8	8	10	2.75	Equatorial fork	AC	—	6x30	1.25	27	\$1,099
Meade	#2080B	8	10	3.00	Equatorial fork	AC	—	6x30	1.25	53	\$1,149
Celestron	C8+	8	10	2.75	Equatorial fork	DC	✓	6x30	1.25	28	\$1,399
Meade	LX100Q	8	10	3.00	Equatorial fork	DC	✓	8x50	1.25	66	\$1,695
Celestron	C8+ Computer	8	10	2.75	Equatorial fork	DC	✓	6x30	1.25	30	\$1,799
Celestron	Ultima 8-PEC	8	10	2.75	Equatorial fork	DC	✓	7x50	1.25	66	\$1,899
Meade	LX100	8	10	3.00	Equatorial fork	DC	✓	6x30	1.25	66	\$1,995
Meade	LX100	8	6.3	3.45	Equatorial fork	DC	✓	6x30	1.25	66	\$1,995
Meade	LX200	8	10	3.00	Computerized altaz	DC	✓	8x50	1.25	61	\$2,295
Meade	LX200	8	6.3	3.45	Computerized altaz	DC	✓	8x50	1.25	61	\$2,295
Celestron	Ultima 2000	8	10	n/a	Equatorial fork	DC	✓	8x50	1.25	n/a	\$2,495
10- to 16-inch Schmidt-Cassegrains											
Meade	#2120B	10	10	3.70	Equatorial fork	AC	—	8x50	1.25	76	\$1,449
Meade	10" LX100	10	10	3.70	Equatorial fork	DC	✓	8x50	1.25	109	\$2,695
Meade	10" LX100	10	6.3	4.00	Equatorial fork	DC	✓	8x50	1.25	109	\$2,695
Meade	10" LX200	10	10	3.70	Computerized altaz	DC	✓	8x50	1.25	85	\$2,895
Meade	10" LX200	10	6.3	4.00	Computerized altaz	DC	✓	8x50	1.25	85	\$2,895
Celestron	CG-11	11	10	4.00	German equatorial	DC	✓	7x50	1.25	99	\$3,399
Celestron	11" Ultima 2000	11	10	n/a	Computerized altaz	DC	✓	6x50	1.25	n/a	\$3,575
Meade	12" LX200	12	10	4.00	Computerized altaz	DC	✓	8x50	2	176	\$3,995
Celestron	Compustar 14	14	11	4.50	Equatorial fork	DC	✓	7x50	2	181	\$9,999
Meade	16" LX200	16	10	5.00	Computerized altaz	DC	✓	8x50	2	160	\$14,995
Maksutov-Newtons and Maksutov-Cassegrains											
Cosmos	MC-90	3.7	5.6	1.20	—	—	—	—	1.25	2.9	\$257
Questar	3.5 Standard	3.5	14.4	1.18	Equatorial fork	AC/DC	—	6x	1.25	8	\$3,145
Questar	3.5 Duplex	3.5	14.4	1.18	Equatorial fork	AC/DC	✓	6x	1.25	8	\$3,390
JMI	MK-65	5.9	10	2.10	opt.	—	—	10x30	1.25	9.4	\$895
Ceravolo	HD145*	5.7	6	1.00	opt.	—	—	—	2	12	\$1,895
FJR Manuf.	Vega 6*	6	4	n/a	German equatorial	DC	✓	6x30	2	n/a	\$4,995
Zeiss	MAK 180/1800	7	10	2.30	opt.	—	—	7.5x42	2	33	\$6,000
Questar	Questar 7	7	14.4	2.35	—	—	—	12x	1.25	22	\$6,500
Ceravolo	HD216*	8.5	6	1.50	opt.	—	—	—	2	30	\$4,350
Ceravolo	HD216-PV*	8.5	4	2.60	opt.	—	—	—	2	30	\$5,350
Ceravolo	HD355 Custom*	14	5	2.60	opt.	—	—	—	2	100	\$18,000

* These telescopes are Maksutov Newtonians; other Maksutovs are Cassegrain designs.

NOTE: All telescopes on this list that include mounts also have manual or electric slow-motion controls and setting circles. Telescopes listed in order of increasing aperture. Telescopes of same or similar aperture listed in order of increasing price. Prices are typical selling prices at full-service dealers; prices may vary from dealer to dealer. n/a = data not available; opt. = optional.

contrast. Enhanced coatings are well worth the extra cost.

Motor Drive. If the telescope has an equatorial mount, does it include a motor or "clock" drive for automatically turning the telescope from east to west? If not, is one available as an option? AC drives are the least expensive but require an additional inverter box to power them from a 12 volt battery in the field. DC drives operate directly from supplied battery packs or from a car battery. "Dual-axis drives" include a second motor for adjusting the telescope in the north-south direction.

Speed Controls. Many DC drives come with a hand controller with buttons for speeding up or slowing down the motor. The common 2x speed is for fine guiding when taking astrophotos; an 8x, 16x, or 32x speed is for motorized panning around small areas of the sky. Some drive controls also feature speeds for tracking the Moon and Sun, in addition to a standard sidereal tracking rate for the stars. AC drives require an extra drive corrector device for adding these speed control capabilities.

Setting Circles. Equatorial mounts often include a graduated dial on each axis. Many beginners assume these set-

ting circles will make it easy to dial in astronomical objects. But for circles to work, the mount must be precisely polar aligned, and the circles themselves must be accurately engraved and calibrated to the sky. Most beginners find they are unable to put setting circles to good use, and even many experienced observers never use them, preferring instead to star-hop to their celestial destinations with the aid of a star chart and finderscope. Setting circles are nice to have but not essential.

Computers. Microprocessors have made digital setting circles and computerized drives possible. These electronic finding aids have impressive capabilities. Most are clever enough not to require polar alignment, and they can guide you to thousands of deep-sky objects programmed into the computer's memory. These high-tech features add several hundred dollars to the cost of a telescope, but they do work quite well. Some telescope kits are avail-

TELESCOPE PERFORMANCE LIMITS

Aperture (inches)	Resolving Power (arcseconds)	Faintest Star Visible	Maximum Magnification
2.4	2.0	11.6	120x
3	1.5	12.2	150x
4	1.2	12.7	200x
5	0.95	13.2	250x
6	0.8	13.6	300x
8	0.65	14.2	400x
10	0.5	14.7	500x
12.5	0.4	15.2	600x
16	0.3	15.7	600x
20	0.24	16.2	600x

Use these figures as a general guideline to the performance of various aperture telescopes. Actual performance will depend on the sky conditions, the experience of the observer, and the quality of the telescope's optics.

able that allow you to add third-party digital setting circles later if you wish.

Making the Big Decision

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astronomers is "Buy the largest aperture telescope you can afford." Fair advice but it ignores one very important factor — portability. A big but affordable telescope is of little value if it requires so much effort to set up that you lose interest in using it. The best telescope for you is the one you'll use most often.

Ask yourself these questions: To use your telescope will you have to carry it

down stairs? Through narrow doorways? If so, how wide is the scope? Will you be disassembling it and packing it into your car to drive out to your site? How many pieces does the scope break down into? Will the scope fit into your car? How heavy is the biggest component? Can you lift it easily? A telescope you can leave assembled and carry out to your site as a single unit will get used far more

often than one you'll have to piece together each night.

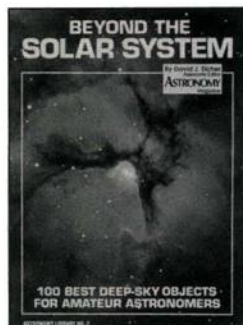
In addition, consider where you will be doing most of your observing from. A large-aperture "light-bucket" telescope works best under dark skies. If you will be doing most of your viewing from a rural site and want to pursue faint deep-sky objects, then go for the aperture.

Other Reflectors

Manufacturer	Model	Aperture (in.)	F/ratio	Secondary mirror size (in.)	Mount design	Drive	Speed controls	Finder	Focuser size (in.)	Total weight (lbs.)	Average selling price
Richfield Newtonians (Ultrafast f/ratio reflectors)											
Cosmos	Wide Field	4.25	5	1.25	opt.	—	—	opt.	1.25	7	\$329
Cosmos	Ultra-wide Field	4.25	4	1.52	opt.	—	—	opt.	1.25	6	\$347
Parks	Companion	4.5	5	1.33	—	—	—	6x30	1.25	5	\$499
Cosmos	Wide Field	6	5	1.80	opt.	—	—	opt.	2	13	\$449
Cosmos	Ultra-wide Field	6	4	2.14	opt.	—	—	opt.	2	12	\$495
Parks	Nitelight	6	3.5	1.83	German equatorial	opt.	✓	6x30	1.25	55	\$1,199
Star Liner	Richfield	6	4	—	German equatorial	AC	—	6x30	1.25	70	\$2,990
Cosmos	Wide Field	8	5	2.14	opt.	—	—	opt.	2	21	\$649
Cosmos	Ultra-wide Field	8	4	2.60	opt.	—	—	opt.	2	19	\$695
Parks	Nitelight	8	3.5	2.60	German equatorial	opt.	✓	8x50	2	65	\$1,399
Parks	Superior Nitelight	8	3.5	2.60	German equatorial	DC	✓	8x50	2	165	\$2,799
Star Liner	Richfield	8	4	—	German equatorial	AC	—	6x30	1.25	75	\$3,200
Cosmos	Ultra-wide Field	10	4.5	2.80	opt.	—	—	opt.	2	27	\$895
Parks	Nitelight	10	3.5	3.10	German equatorial	DC	✓	8x50	2	198	\$3,199
Star Liner	Richfield	10	4	n/a	German equatorial	AC	—	10x50	2	150	\$4,175
Star Liner	Richfield	12.5	4	n/a	German equatorial	AC	—	10x50	2	200	\$4,890
Parks	Nitelight	12.5	3.5	4.00	German equatorial	DC	✓	8x50	2	235	\$4,999
Parks	Nitelight	16	3.5	5.00	German equatorial	DC	✓	8x50	2	605	\$14,099
Tilted-Component Telescopes (Long-focus unobstructed reflectors)											
Iowa Scientific	SCH-426	4.25	26	0.00	German equatorial	opt.	—	6x30	2	45	\$800
Iowa Scientific	SCH-630	6	30	0.00	German equatorial	opt.	—	6x30	2	55	\$1,050
Portable Cassegrains and Combination Newtonian/Cassegrains (6- to 11-inch models)											
Parks	HIT Newt./Cass.	6	3.5/12	1.8/2.1	German equatorial	DC	—	6x30	1.25	70	\$2,299
Takahashi	Mewlon 180ES	7	12	2.10	German equatorial	DC	✓	7x50	2	68	\$3,695
Optical Guid.	DK7 Digital	7	12	2.10	German equatorial	AC/DC	—	8x50	2	70	\$3,995
Star Liner	Quality Cass.	8	12	n/a	German equatorial	AC	—	6x30	1.25	120	\$2,790
Parks	HIT Newt./Cass.	8	3.5/12	2.6/2.9	German equatorial	DC	—	8x50	2	81	\$2,799
Star Liner	Newt./Cass.	8	4.0/12	n/a	German equatorial	AC	—	6x30	1.25	120	\$3,740
Takahashi	Mewlon 210H	8.3	11.5	n/a	German equatorial	DC	✓	7x50	2	78	\$4,124
Star Liner	Quality Cass.	10	10	n/a	Equatorial fork	AC	—	10x50	2	145	\$2,890
Star Liner	Newt./Cass.	10	4.8/10	n/a	Equatorial fork	AC	—	10x50	2	150	\$3,295
Parks	HIT Newt./Cass.	10	3.5/12	3.1/3.5	German equatorial	DC	—	8x50	2	225	\$4,599
Optical Guid.	CC10 Classical	10	15	3.50	German equatorial	DC	—	8x50	2	180	\$8,375
Optical Guid.	RC10 Ritchey	10	8.5	4.60	German equatorial	DC	✓	8x50	2.5	160	\$8,575
Takahashi	Mewlon 250SE	10	12	3.10	German equatorial	DC	✓	7x50	2	140	\$8,695
Observatory Reflectors (12.5-inch and larger Newtonians, Cassegrains, and Combinations)											
Parallax	PI 320 High-Res.	12.5	6	2.14	opt.	—	—	8x50	2	70	\$2,795
Star Liner	Quality Newt.	12.5	5	n/a	Equatorial fork	AC	—	10x50	2	180	\$2,895
Star Liner	Quality Cass.	12.5	10	n/a	Equatorial fork	AC	—	10x50	2	190	\$3,850
Star Liner	Newt./Cass.	12.5	3.8/11	n/a	Equatorial fork	AC	—	10x50	2	195	\$4,250
Parks	HIT Newt./Cass.	12.5	3.5/12	4/4.2	German equatorial	DC	—	8x50	2	270	\$6,599
Parks	Observatory	12.5	5	3.10	German equatorial	DC	✓	8x50	2	515	\$10,999
Optical Guid.	RC12.5 Ritchey	12.5	9	5.00	German equatorial	AC	—	8x50	2.5	240	\$15,338
ASKO/RVR	SE-310 Cass.	12.2	15	4.30	German equatorial	DC	✓	8x50	2	1,016	n/a
Optical Guid.	RC14.5 Ritchey	14.5	7.9	6.00	German equatorial	AC	—	8x50	2.5	255	\$19,785
D & G	Classical Cass.	20	12	5.00	opt.	—	—	8x50	2.7	90	\$11,990
Parks	Observatory	16	5	4.00	German equatorial	DC	✓	8x50	2	695	\$13,999
Parks	HIT Newt./Cass.	16	3.5/20	5/3.5	German equatorial	DC	—	8x50	2	635	\$18,999
DFM	CCT-16	16	12	4.50	Equatorial fork	DC	✓	9x60	—	350	\$72,200
Optomechanic	Cassegrain	16	n/a	n/a	Equatorial fork	n/a	✓	n/a	n/a	n/a	\$85,000
Alaska Appl.	16" Springfield	16	n/a	6.00	Springfield	DC	—	—	3	400	n/a

Also available: 14" to 40" Cassegrains from ASKO; 16" and 20" Ritchey-Chrétien Cassegrains from Optical Guidance Systems; 14.5" and 16" Newtonian tube assemblies from Parallax; 14.25" to 20" Newtonians, Cassegrains, and Newtonian-Cassegrains from Star Liner.

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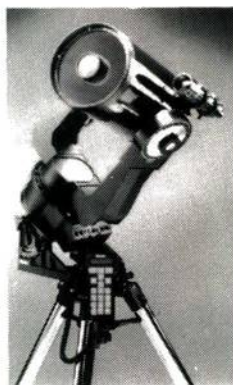
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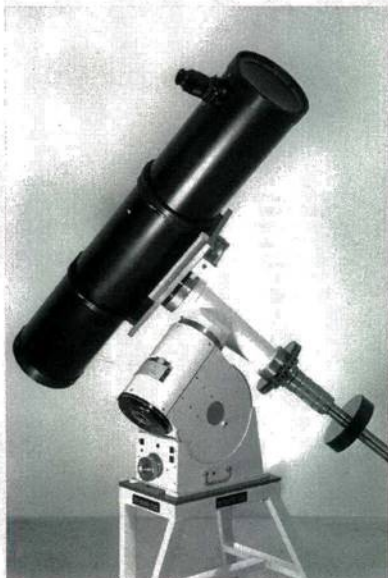
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The Byers Series IICT features a patented computer-controlled tangent-arm driving system that performs 6 million calculations in a two-hour period to totally eliminate the periodic tracking error that plagues all worm-gear drives. The proven design and high-quality craftsmanship make the Byers Series IICT the most accurate equatorial mount available in the world today.



Unguided High-Resolution Image of M15

The visibility of globular cluster M15's stellar core in this high-power *unguided* 5 minute exposure CCD image attests to the Ceravolo Optical Systems HD216's optical excellence and the Byers Series IICT's flawless tracking. The field is 2.4 arc minutes across, and each pixel covers 0.8 arc seconds of sky. The 3.8 m effective focal length was achieved with a 2.9x Barlow lens.

What do our customers say about the HD216?

"The overall optical quality is exceptional. I have never looked through any reflective telescope (Newtonian or compound) with the overall optical excellence of the HD216... I have split several close double stars with separations of 0.55 to 1.0 arc seconds using powers of 324x, 555x, 648x and 972x under conditions of excellent seeing... In summary, I believe the HD216 to be a very close approximation of what an 8" apochromat would be like."

— Don J. Colton, Midvale, Utah

The HD216 is also available with custom-fitted mounting systems from Astro-Physics and Celestron/Losmandy.

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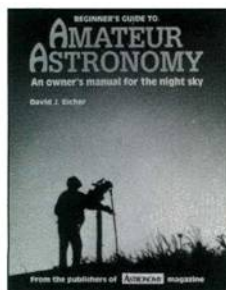
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But if your main viewing site will be a bright urban location, you will likely spend most nights looking at the Moon, planets, and bright deep-sky objects. A telescope with no more than 8 inches aperture can provide outstanding views of those targets, and be highly portable for occasional trips to rural sites. Telescopes in the 4- to 8-inch range are bothered less by the blurring effects of turbulence in the atmosphere, which on most nights gives them an advantage over larger scopes when it comes to sharp views of the planets.

Also ask yourself if you want to do astrophotography. If so, you'll definitely need a telescope with an equatorial mount and clock drive. In today's market, the Schmidt-Cassegrains and apochromatic refractors are the "off-the-shelf" telescopes most easily adapted to astrophotography. Be prepared to spend about \$2,000 to \$4,000 for a telescope capable of taking good astrophotos and its required accessories.

Of course, price is a critical factor. If you're looking for a good entry-level telescope for under \$1,000, any of the following will serve you well:

- A 3-inch (80 to 90mm) or 4-inch achromatic refractor (\$450 to \$1,000) — easy to use, with rugged, maintenance-free construction and sharp optics.

- A 4- to 6-inch Newtonian reflector on an equatorial mount (\$400 to \$800) — good aperture with the convenience of equatorial tracking.

- A 6- to 10-inch reflector on a Dobsonian mount (\$300 to \$600) —

A MOTOR DRIVE on an equatorial mount will keep objects centered in the field automatically. If a motor is not standard, check to see if one can be added later.

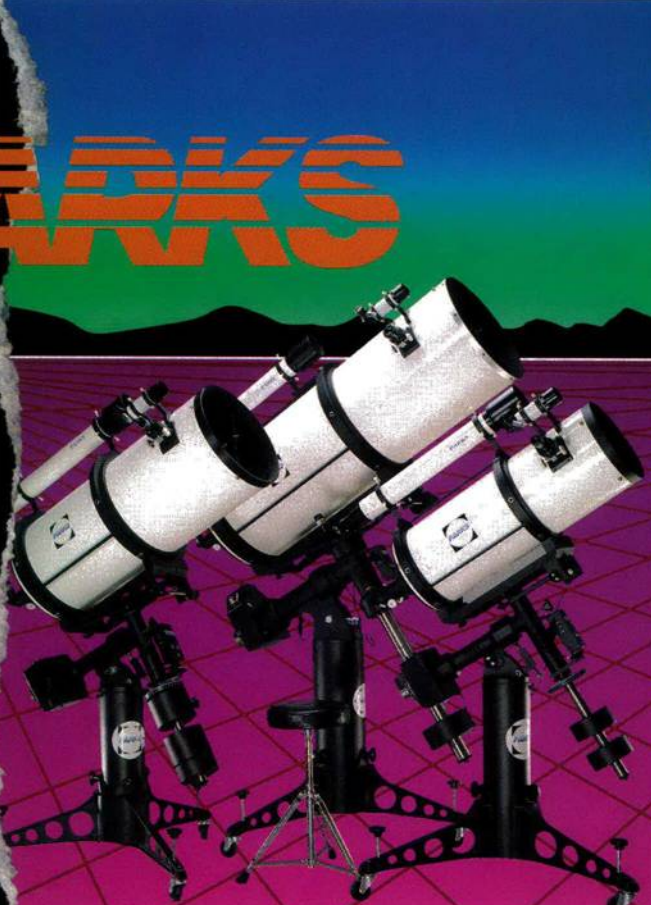


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- A 4- or 5-inch Schmidt-Cassegrain (\$700 to \$1,000) — extremely compact with the added capability of at least limited astrophotography.

If you plan to spend over \$1,000, the selection explodes with bigger telescopes, more sophisticated optics, hand-crafted mounts, and computerized drives. The selection and prices of telescopes have never been better.

For the specifics, check out the detailed tables in this guide — the most complete listing of telescopes in print today. It's your shopping center for astronomy.

Enjoy!

Who Makes Telescopes?

Studying the product literature from telescope manufacturers is a good way to learn more about telescopes in general. Most companies have brochures available free or at nominal cost. Write or call the following companies for more information about their products and for the location of the dealers near you.

TELESCOPE MANUFACTURERS

These companies sell complete telescopes, optical tube assemblies, and telescope mounts.

Alaska Applied Sciences Inc., P.O. Box 020993, Juneau, AK 99802, (907) 586-1426.
ASKO, c/o R.V.R. Optical, P.O. Box 62, Eastchester, NY 10709, (914) 337-4085.
Astro-Physics, 11250 Forest Hills Road, Rockford, IL 61111, (815) 282-1513.
Autoscope Corporation, 2637 Midpoint Drive, Suite D, Fort Collins, CO 80525, (303) 224-5439.
Bausch & Lomb Sport Optics Division, 9200 Cody, P.O. Box 14930, Overland Park, KS 66214, (913) 888-0220.
Celestron International, 2835 Columbia St., Torrance, CA 90503, (310) 328-9560.
Cervaro Optical Systems, P.O. Box 1427, Ogdensburg, NY 13669, (613) 258-4480.
Cosmos Ltd., 9215 Waukegan Road, Morton Grove, IL 60053, (708) 827-4846.
Coulter Optical, P.O. Box K, Idyllwild, CA 92549, (714) 659-4621.
D&G Optical, 6490 Lemon St., East Petersburg, PA 17520, (717) 560-1519.
DFM Engineering, Inc., 1035 Delaware Avenue, Unit D, Longmont, CO 80501, (303) 678-8143.
Edmund Scientific, 100 East Gloucester Pike, Barrington, NJ 08007, (609) 547-3488.
Europtik, Ltd., P.O. Box 319, Dunmore, PA 18512, (717) 347-6049.
FJR Manufacturing, Inc., 101 Progress Drive, West Bend, WI 53095, (414) 338-3389.
Fraunhofer Systems Company, 14418 Dickens Street, Suite #6, Sherman Oaks, CA 91423, (818) 986-3601.

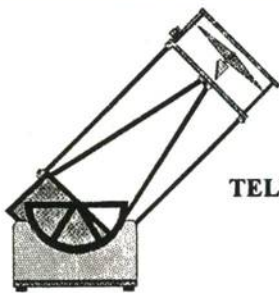
Iowa Scientific Optical, 4231 Northwest Drive, Des Moines, IA 50310, (515) 255-0166.
JMI (Jim's Mobile Industries), 810 Quail Street, Unit E, Lakewood, CO 80215, (303) 233-5353.
Jupiter Telescope Company, 810 Saturn Street, Suite 16, Jupiter, FL 33477, (407) 694-1154.
Light Speed Telescopes, Inc., 3991 Weld County Road, #18 East Unit, Erie, CO 80516, (303) 678-9547.
MAG1 Instruments, 16342 W. Coachlight Drive, New Berlin, WI 53151, (414) 785-0926.
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Optical Guidance Systems, 2450 Huntingdon Pike, Huntingdon Valley, PA 19006, (215) 947-5571.
Optomechanics Research, Box 87, Vail, AZ 85641, (602) 647-3332.
Orion Telescope Center, 2450 17th Avenue, P.O. Box 1158, Santa Cruz, CA 95061, (800) 447-1001.
Parallax Instruments, 8318 Pineville-Matthews Road, Suite 708, Box 192, Charlotte, NC 28226, (704) 542-4817.
Parks Optical, 270 Easy St., Simi Valley, CA 93065, (805) 522-6722.
Photon Instrument, Ltd., 122 East Main Street, Mesa, AZ 85201, (602) 661-1901.
Questar Corporation, Route 202, Box 59, New Hope, PA 18938, (215) 862-5277.
Safari Telescopes, 110 Pascask Road, Pearl River, NY 10965, (914) 735-4163.
Simmons Outdoor Corporation, 14530 SW 119 Ave., Miami, FL 33186, (305) 252-0477.
Sky Designs, 4100 Felps, Suite C, Colleyville, TX 76034, (817) 581-9878.
Sky Instruments, P.O. Box 3164, Vancouver, B.C., Canada V6B 3Y6, (604) 270-2813.
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Takahashi, c/o Land, Sea, and Sky/Texas Nautical Repair, 3110 S. Shepherd, Houston, TX 77098, (713) 529-3551.
Tasco, 7600 MW 26th St., Miami, FL 33122, (305) 591-3670.
Tectron, 2111 Whitfield Park Avenue, Sarasota, FL 34243, (813) 758-9890.
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Torus Optical Works, 67 Bon-Aire, Iowa City, IA 52240, (319) 339-0524.
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Zeiss (Carl Zeiss Jena GmbH), Astronomical Instruments Division, Postfach 125, Tatzendpromenade 1A, Jena, Germany, O-6900, (49) 3641-588-2557; in North America contact Barlow Pepin, General Agent, 783 S. Atmore Circle, Deltona, FL 32725, (904) 789-5007.

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Frederick Stager, P.O. Box 61, Birchrunville, PA 19421, (215) 827-7026.
Hollywood General Machining Inc./Losmandy, 1033 N. Sycamore Ave., Los Angeles, CA 90038, (213) 462-2855.
Motion Control Systems, P.O. Box 19632, Portland, OR 97280, (503) 244-0503.
Mountain Instruments, 5050 Laguna Blvd., Suite 112-399, Elk Grove, CA 95758, (916) 265-3183.
Optic-Craft Machining, 33918 Macomb, Farmington, MI 48024, (313) 476-5893.
Thomas Mathis Co., 830 Williams St., San Leandro, CA 94577, (415) 483-3090.



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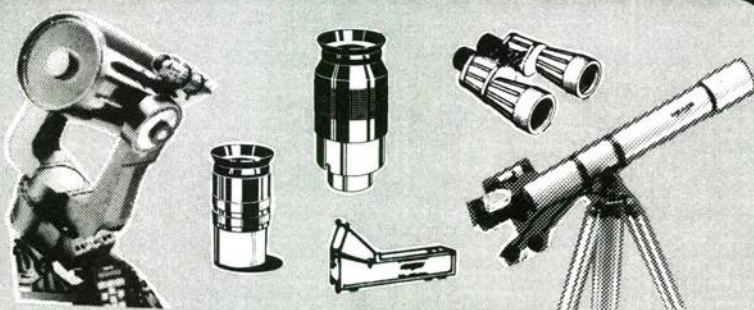
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Color band - white. Class "B" filters are made with polished glass and multi-alloy coating. These filters offer great durability and will provide many years of service and enjoyment with normal use. Can be used visually and for photography. Light transmission is 1/1000th of 1%.



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Color band - red. Class "C" filters are specifically coated to a lighter density (ND-4). They are for photographic use only. This filter is intended for use by professionals and serious hobbyists. Light transmission is 1/100th of 1%.



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2.0"-2.4"	\$57.00	\$42.00	\$75.00
2.5"-3.4"	60.00	46.00	78.00
3.5"-4.5"	70.00	52.00	92.00
4.6"-5.5"	90.00	67.00	117.00
5.6"-6.5"	97.00	72.00	127.00
6.6"-8.5"	117.00	87.00	152.00
8.6"-10.5"	127.00	97.00	166.00
10.6"-11.5"	147.00	107.00	191.00
11.6"-13.5"	167.00	127.00	217.00
13.6"-14.0"	187.00	147.00	243.00

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Accessories For Scopes

Looking to improve your telescope, or add exciting new capabilities? Take a browse through the shopping mall of telescope accessories.



All telescope owners catch it; perhaps you already have — the itch to buy accessories to make night sky exploring little easier and a lot more rewarding. Some are must-have accessories that should be in everyone's observing kit. Others rank a little further down the shopping list but can expand your universe of backyard astronomy.

Must-Haves

Eyepieces (\$40 to \$400 each)

Most telescopes come with at least one eyepiece. Adding more eyepieces is essential if you want to have a range of magnifications. The most important specification of an eyepiece is its focal length. Eyepieces are available in focal lengths from 55mm to 2.4mm. The shorter the focal length, the higher the power the eyepiece will produce. To calculate the power any eyepiece will give on your telescope, divide the focal length of your telescope by the focal length of the eyepiece. A 10mm eyepiece on a 1,500mm-focal-length scope, for example, will give 150x. The same eyepiece on a 1,000mm telescope would give 100x.

For most of your observing, all you need are three eyepieces: low power to find objects (25x to 50x), medium power to find detail (80x to 120x), and high power to discern even greater detail (150x to 200x). Eyepieces in the 55mm to 26mm range are low-power models. Eyepieces with focal lengths from 25mm to 13mm give medium power, while ones from 12mm to 2.4mm are high-power. One eyepiece from each range of magnification makes a good basic set. When selecting eyepieces, however, watch two rules:

- Don't buy eyepieces that yield more than 50x per inch of aperture with your telescope — they will produce too much magnification.
- Don't buy eyepieces that yield less than 5x per inch of aperture — they will give too little power and will not work well with reflectors.

Besides focal length, eyepieces also differ in their field of view and their optical design. Economy eyepieces such as Kellners, Modified Achromats, and Edmund's RKE designs provide good image quality with an average field of view (40° to 45°). A step up in quality are orthoscopic and Plössl designs — they provide high contrast and better correction of optical aberrations but still feature a standard field of view (45° to 55°). Many amateurs prefer these models for planetary viewing.

Telescope Eyepieces

Brand	Series	Focal Length	Apparent FOV (°)	Coatings	Eye Relief (mm)	Eyecups	Parfocal	Retail
Standard Field of View — 0.965-inch Barrel								
Celestron	Kellner	40	35	C	25	—	—	\$39
Celestron	Kellner	30	40	C	20	—	—	\$39
Celestron	Kellner	25	42	C	16	—	—	\$39
Celestron	Kellner	18	42	C	12	—	—	\$39
Celestron	Kellner	10	43	C	9	—	—	\$39
Celestron	Plössl	26	50	MC	22	—	✓	\$49
Celestron	Plössl	17	52	MC	13	—	✓	\$49
Celestron	Plössl	10	52	MC	6.5	—	✓	\$49
Celestron	Plössl	7.5	52	MC	5	—	✓	\$49
Edmund	Kellner	25	39	C	n/a	—	—	\$49
Edmund	Kellner	18	46	C	n/a	—	—	\$49
Edmund	Kellner	12	38	C	n/a	—	—	\$49
Edmund	Kellner	9	45	C	n/a	—	—	\$49
Edmund	Kellner	6	40	C	n/a	—	—	\$49
Edmund	Orthoscopic	25	n/a	C	n/a	—	—	\$70
Edmund	Orthoscopic	18	n/a	C	n/a	—	—	\$70
Edmund	Orthoscopic	12.5	n/a	C	n/a	—	—	\$70
Edmund	Orthoscopic	6	n/a	C	n/a	—	—	\$70
Edmund	Orthoscopic	4	n/a	C	n/a	—	—	\$70
Meade	Modified Achr.	40	36	C	18	—	—	\$29
Meade	Modified Achr.	25	40	C	16	—	—	\$29
Meade	Modified Achr.	12	40	C	8	—	—	\$29
Meade	Modified Achr.	9	40	C	6	—	—	\$29
Orion	Achr. Huygenian	40	30	MC	14	—	—	\$37
Orion	Kellner	25	38	MC	15	—	—	\$37
Orion	Kellner	18	38	MC	10	—	—	\$37
Orion	Orthoscopic	12.5	40	MC	9	—	—	\$50
Orion	Orthoscopic	9	44	MC	6	—	—	\$50
Orion	Orthoscopic	7	44	MC	5	—	—	\$50
Orion	Orthoscopic	5	44	MC	5	—	—	\$50
Parks	.96 Series	22	32	C	n/a	—	—	\$38
Parks	.96 Series	20	32	C	n/a	—	—	\$38
Parks	.96 Series	12.5	32	C	n/a	—	—	\$38
Parks	.96 Series	9	32	C	n/a	—	—	\$38
Parks	.96 Series	6	32	C	n/a	—	—	\$38
Parks	.96 Series	4	32	C	n/a	—	—	\$38
Tuthill	Orthoscopic	25	n/a	C	n/a	—	✓	\$55
Tuthill	Orthoscopic	18	n/a	C	n/a	—	✓	\$55
Tuthill	Orthoscopic	12.5	n/a	C	n/a	—	✓	\$55
Tuthill	Orthoscopic	9	n/a	C	n/a	—	✓	\$55
Tuthill	Orthoscopic	7	n/a	C	n/a	—	✓	\$55
Tuthill	Orthoscopic	6	n/a	C	n/a	—	✓	\$55
Tuthill	Orthoscopic	5	n/a	C	n/a	—	✓	\$55
Tuthill	Orthoscopic	4	n/a	C	n/a	—	✓	\$55
Zeiss Jena	Orthoscopic	25	40	C	20	—	✓	\$165
Zeiss Jena	Orthoscopic	16	40	C	13	—	✓	\$165
Zeiss Jena	Orthoscopic	12.5	40	C	10	—	✓	\$165
Zeiss Jena	Orthoscopic	10	40	C	8	—	✓	\$165
Zeiss Jena	Orthoscopic	6	40	C	5	—	✓	\$165
Zeiss Jena	Orthoscopic	4	40	C	3	—	✓	\$165
Standard Field of View — 1.25-inch Barrel								
Adorama	Pro-Optic Plössl	40	46	C	31	—	✓	\$70
Adorama	Pro-Optic Plössl	25	50	C	22	—	✓	\$42
Adorama	Pro-Optic Plössl	17	52	C	14	—	✓	\$42
Adorama	Pro-Optic Plössl	10	52	C	6.5	—	✓	\$42
Adorama	Pro-Optic Plössl	7.5	52	C	5	—	✓	\$42
Celestron	Kellner	25	50	MC	18	—	✓	\$44
Celestron	Plössl	40	46	MC	31	—	✓	\$64
Celestron	Plössl	26	50	MC	22	—	✓	\$54
Celestron	Plössl	17	52	MC	13	—	✓	\$54
Celestron	Plössl	10	52	MC	6.5	—	✓	\$54
Celestron	Plössl	7.5	52	MC	5	—	✓	\$54
Celestron	Ultima	42	36	FMC	32	✓	—	\$149
Celestron	Ultima	35	49	FMC	25	✓	—	\$129
Celestron	Ultima	30	50	FMC	21	✓	✓	\$99
Celestron	Ultima	24	51	FMC	18	✓	✓	\$99
Celestron	Ultima	18	51	FMC	13	✓	✓	\$89

(continued on page 44)

Wide-angle eyepieces with apparent fields of 65° to 75° such as Erfles, Königs, wide-fields, and other proprietary designs contain more lens elements and can show more of the sky. Extra-wide-angle eyepieces such as Meade's Ultra Wide Angles and Tele Vue's Nagler series boast apparent fields of 80° or more, providing picture-window views of the universe. All wide-angle eyepieces are terrific for deep-sky viewing but cost more than most standard-field models.

To determine how much of the sky any eyepiece will show on your telescope (its "actual" field), divide the eyepiece's "apparent" field by the magnification that eyepiece will provide. An 80° extra-wide-angle model that gives 160x on your telescope will show you 1/2° of sky, enough to just take in the whole Moon.

The accompanying tables break down the various eyepieces into standard, wide-field, and extra-wide-field categories. We also list the eyepieces by barrel diameter. Ones with 0.965-inch barrels are for imported telescopes that still use this smaller accessory size. Most new telescopes accommodate the more popular 1.25-inch-barrel eyepieces. Some wide-angle eyepieces come in giant 2-inch barrels. You'll need a 2-inch focuser to use these.

These days, all eyepieces feature optical coatings on the lenses. These increase light transmission and reduce ghost images from internal reflections. Most eyepieces also have barrels that are threaded to accept filters. Some eyepieces come with rubber eye cups, nice added touches that help block stray light. As another plus, eyepieces that are part of a series are often parfocalized — each eyepiece in the series focuses at close to the same point. For more information on these essential accessories, see "Choosing Eyepieces: A Buyer's Guide," in the June 1993 ASTRONOMY.

Finderscopes (\$45 to \$250)

Your telescope likely came with a finderscope. If not, you'll need to add one. Or perhaps you'd like to upgrade to a larger finderscope. Finders with apertures of 50mm, 60mm, or even 80mm provide enough light-gathering power to reveal many deep-sky objects right in the finder. No more guessing if you're aimed at the right spot. Right-angle finders are comfortable to look through when aimed high up but present a mirror-image view of the sky, making it confusing to compare the finder's view with a star chart. Straight-through finders avoid this. Some finders also offer illuminated reticles and special reticle patterns to aid in polar alignment, both welcome features.

As an alternative to a traditional finderscope, many amateurs use a reflex viewing sight, a nontechnical device that

STAR CHARTS are your road maps to the sky. Without them you won't know what to look for or where to find anything. Don't forget a red flashlight for reading the charts at night.

has a plexiglas window in which you see a red bull's-eye projected onto the sky. These lightweight finders are popular with owners and manufacturers of Dobsonians but work well with any telescope.

Star diagonals (\$45 to \$150)

Most refractors and Schmidt-Cassegrains come with a star diagonal. Without it, you would need to peer up through the telescope, a neck-straining task when you're looking high in the sky. Prism-type 90° star diagonals provide excellent image quality. A few telescopes come with 45° Amici-prism star diagonals; these are fine for terrestrial viewing but produce distorted star images. Replace them with a 90° type. If you wish to attach giant 2-inch eyepieces to your refractor or Schmidt-Cassegrain, you'll need a 2-inch star diagonal. Most of these are mirror-type designs and sell for \$100 to \$150. Check with the dealer or manufacturer about the compatibility of 2-inch accessories with your telescope.

Star charts (\$20 to \$50)

A good star atlas is an essential accessory for any telescope. An atlas that shows stars up to 6th-magnitude (such as the *Bright Star Atlas*, the *Cambridge Star Atlas 2000.0*, the *Color Star Atlas*, the *Mag 6 Star Atlas*, or *Norton's 2000.01*) is a minimum for any telescope owner. Owners of moderate-to-large aperture telescopes will want the 8th-magnitude *Sky Atlas 2000.0*, while deep-sky diehards won't be happy unless they have the 9th-magnitude two-volume *Uranometria 2000.0*.

Flashlights (\$10 to \$25)

What do you read your star chart with in the dark? A red-filtered flashlight. The dim red light preserves your night vision. Flashlights with red LEDs work best — the batteries last almost forever. Small non-metal flashlights you can hold with your teeth are helpful for lighting when you need both hands free.

Anti-dew accessories (\$25 to \$150)

If you have a refractor, Schmidt-Cassegrain, or Maksutov telescope, you soon learn about dew. It forms at night on any exposed optical surface, ruining the view. Most refractors come with a dewcap tube that extends past the main lens to keep dew off. Similar detachable tubes are available as essential accessories for Schmidt-Cassegrains. Small hairdryer-like dew removers can dry off



soaked optics, but under very damp conditions, even dew removers and dew-caps won't be enough. The most effective method of keeping optics dry is using heated coils that wrap around telescope and eyepiece tubes, keeping the optics just warm enough to ward off dew. Both 110-volt AC and 12-volt DC models are available.

Counterweights (\$40 to \$150)

Adding heavy eyepieces or finderscopes to Dobsonian reflectors and fork-mounted Schmidt-Cassegrains can sometimes throw these telescopes far out of balance. An unbalanced Dobsonian may not stay put and a Schmidt-Cassegrain may not track properly. Counterweights added to the tube may be the answer.

Cases and covers (\$50 to \$300)

As soon as you collect a few eyepieces and filters, you'll need a case to carry them in. Foam-lined camera cases are ideal and are available in all sizes and construction styles. Padded carrying bags are also handy for protecting tripods and mounts from the rigors of transport. If you plan to leave your scope outside during weekend observing trips, a weather-proof cover is another necessity.

Chairs and ladders (\$50 to \$150)

You might consider it a luxury item, but after you've been crouching at the eyepiece for a few hours, a place to sit becomes necessary. Observing stools offer adjustable seats, so you can place your eye comfortably at the eyepiece no

matter where the telescope is aimed. If you have a large Newtonian reflector with an eyepiece several feet up, an observing ladder or stepstool may be the required accessory.

Can Wait

Filters (\$15 to \$200)

At about \$15 each, colored filters can enhance subtle details in the atmospheres and on the surfaces of planets. Red, yellow, green, and blue filters are most commonly used. A neutral-density or polarizing filter is also helpful for cutting lunar glare.

For enhancing some deep-sky objects, a nebula or light-pollution filter can block the light from streetlights while passing the colors emitted by some nebulae. Broadband filters darken the sky the least but can be used for a mild enhancement of nebulae and galaxies. Narrowband filters have the most dramatic effect but are useful only for emission and planetary nebulae. Although nebula filters work well, they cannot perform miracles. Do not expect them to turn your urban backyard into a dark-sky site. (For more details see "ASTRONOMY Tests Ten Nebula Filters," in the February 1991 issue.)

Both planetary and nebula filters screw into your eyepieces. Solar filters, however, fit over the front of your telescope where they block 99.999 percent of sunlight and cut out harmful infrared and ultraviolet light. Solar filters come in two types — aluminized Mylar (the most economical) and metal-coated glass

Telescope Eyepieces

Brand	Series	Focal Length	Apparent FOV (°)	Coatings	Eye Relief (mm)	Eyecups	Parfocal	Retail
Standard Field of View — 1.25-inch Barrel (cont.)								
Celestron	Ultima	12.5	51	FMC	9	✓	✓	\$89
Celestron	Ultima	7.5	51	FMC	5	✓	✓	\$89
Celestron	Ultima	5	50	FMC	4	✓	✓	\$94
Celestron	Ultima Zoom	6.5-18	var.	MC	16	—	✓	\$139
Celestron	Vixen LV	25	50	FMC	20	✓	✓	\$120
Celestron	Vixen LV	20	50	FMC	20	✓	✓	\$120
Celestron	Vixen LV	15	50	FMC	20	✓	✓	\$105
Celestron	Vixen LV	10	50	FMC	20	✓	✓	\$105
Celestron	Vixen LV	9	50	FMC	20	✓	✓	\$105
Celestron	Vixen LV	6	45	FMC	20	✓	✓	\$105
Celestron	Vixen LV	5	45	FMC	20	✓	✓	\$105
Celestron	Vixen LV	4	45	FMC	20	✓	✓	\$120
Celestron	Vixen LV	2.5	45	FMC	20	✓	✓	\$120
Clavé	Piössl	25	50	FMC	n/a	—	✓	\$275
Clavé	Piössl	20	50	FMC	n/a	—	✓	\$275
Clavé	Piössl	16	50	FMC	n/a	—	✓	\$275
Clavé	Piössl	12	50	FMC	n/a	—	✓	\$275
Clavé	Piössl	10	50	FMC	n/a	—	✓	\$295
Clavé	Piössl	8	50	FMC	n/a	—	✓	\$295
Clavé	Piössl	6	50	FMC	n/a	—	✓	\$295
Clavé	Piössl	5	50	FMC	n/a	—	✓	\$295
Edmund	Kellner	25	39	C	n/a	—	—	\$49
Edmund	Kellner	18	46	C	n/a	—	—	\$49
Edmund	Kellner	12	38	C	n/a	—	—	\$49
Edmund	Kellner	9	45	C	n/a	—	—	\$49
Edmund	Kellner	6	40	C	n/a	—	—	\$49
Edmund	RKE	28.7	45	C	25	✓	✓	\$50
Edmund	RKE	21.5	45	C	19	—	✓	\$50
Edmund	RKE	15	45	C	13	—	✓	\$50
Edmund	RKE	12	45	C	11	—	✓	\$50
Edmund	RKE	8	45	C	8	—	✓	\$50
Edmund	Orthoscopic	25	n/a	C	n/a	—	—	\$70
Edmund	Orthoscopic	18	n/a	C	n/a	—	—	\$70
Edmund	Orthoscopic	12.5	n/a	C	n/a	—	—	\$70
Edmund	Orthoscopic	6	n/a	C	n/a	—	—	\$70
Edmund	Orthoscopic	4	n/a	C	n/a	—	—	\$70
Masuyama	Masuyama	35	52	FMC	n/a	—	✓	n/a
Masuyama	Masuyama	30	52	FMC	n/a	—	✓	n/a
Masuyama	Masuyama	25	52	FMC	n/a	—	✓	n/a
Masuyama	Masuyama	20	52	FMC	n/a	—	✓	n/a
Masuyama	Masuyama	15	52	FMC	n/a	—	✓	n/a
Masuyama	Masuyama	10	52	FMC	n/a	—	✓	n/a
Masuyama	Masuyama	7.5	52	FMC	n/a	—	✓	n/a
Meade	Modified Achr.	40	36	MC	18	—	—	\$30
Meade	Modified Achr.	25	40	MC	16	—	—	\$30
Meade	Modified Achr.	12	40	MC	8	—	—	\$30
Meade	Modified Achr.	9	40	MC	6	—	—	\$30
Meade	3000 Plössl	40	44	MC	29	—	✓	\$80
Meade	3000 Plössl	25	50	MC	16	—	✓	\$60
Meade	3000 Plössl	16	50	MC	10	—	✓	\$60
Meade	3000 Plössl	9.5	50	MC	6	—	✓	\$60
Meade	3000 Plössl	6.7	50	MC	4	—	✓	\$60
Meade	3000 Plössl	5	50	MC	3	—	✓	\$60
Meade	4000 Plössl	40	44	FMC	30	✓	—	\$110
Meade	4000 Plössl	32	52	FMC	20	✓	✓	\$110
Meade	4000 Plössl	26	52	FMC	18	✓	✓	\$88
Meade	4000 Plössl	20	52	FMC	13	✓	✓	\$88
Meade	4000 Plössl	15	52	FMC	9	✓	✓	\$88
Meade	4000 Plössl	12.4	52	FMC	7	✓	✓	\$88
Meade	4000 Plössl	9.7	52	FMC	5	✓	✓	\$88
Meade	4000 Plössl	6.4	52	FMC	2	✓	✓	\$88
Orion	Kellner	40	30	MC	14	—	✓	\$39
Orion	Kellner	25	40	MC	20	—	✓	\$39
Orion	Kellner	18	54	MC	15	—	✓	\$39
Orion	Kellner	12	40	MC	9	—	✓	\$39
Orion	Kellner	9	40	MC	7	—	✓	\$39
Orion	Kellner	6	40	MC	5	—	✓	\$39
Orion	Orthoscopic	25	41	MC	20	—	✓	\$55
Orion	Orthoscopic	18	45	MC	14	—	✓	\$55
Orion	Orthoscopic	12.5	40	MC	12	—	✓	\$55
Orion	Orthoscopic	9	44	MC	6	—	✓	\$55

(continued on page 46)

(with more natural coloration). With either filter you can safely examine our daytime star for sunspots and other surface details.

Barlow lenses (\$50 to \$160)

A Barlow lens will double or triple the power of any eyepiece inserted into it. Using a Barlow in conjunction with a medium-power eyepiece is one way to achieve high magnification (the other is to use a short-focal-length, high-power eyepiece). The advantage to using a Barlow is that you get high power without sacrificing the comfortable eye relief of the medium-power eyepiece. (Eye relief is the distance your eye needs to be from the eyepiece to see the entire field. High-power eyepieces usually have little eye relief, making them difficult to look through.) The disadvantage is that a poor-quality Barlow can add color and reduce image sharpness.

Coma correctors (\$150 to \$225)

Fast Newtonian telescopes, ones with f/4 to f/5 focal ratios, exhibit distorted star images at the edge of the field due to an aberration called coma. Coma correctors are Barlow-like devices you slip between the eyepiece and the focuser. They eliminate coma, giving pinpoint stars across the field, provided you are also using top-quality eyepieces.

Collimation aids (\$50 to \$100)

Owners of Newtonians have to tweak up their telescope's collimation from time to time. A few manufacturers produce special collimation eyepieces that make the task simpler and more accurate.

Vibration dampeners (\$50 to \$100)

Inserted under the legs of your telescope, these footpads absorb vibrations so that bouncing images damp out up to twice as quickly.

Focus motors (\$100 to \$160)

An electric motor to turn the focus knob may seem like a lazybone's luxury, but the advantage is that you can focus without having to touch the telescope. This keeps the image still, making it easier to zero in on the sharpest image. Electric focus kits are available for a wide range of telescope models.

Power packs (\$100 to \$125)

While some mounts with DC motors come with small battery packs, these often last only a few nights on a set of AA or C cells. Adding other electric accessories can boost your power requirements still further. A large-capacity rechargeable battery can power all your telescope functions for many nights and free you from having to string cords over to your car's battery. Astronomy dealers offer Gel-Cel packs suitable for

most applications. Accessories that draw heavy current such as anti-dew heater coils and CCD cameras may require a separate deep-cycle marine battery.

Inverters and drive correctors (\$100 to \$350)

Telescopes with 110-volt AC drives can be operated in the field from 12-volt sources via a device called an inverter. If you wish to do astrophotography, a device called a drive corrector incorporates an inverter as well as circuitry and a hand controller for performing the fine speed corrections necessary for guiding long exposures.

Declination motors (\$100 to \$160)

Many equatorial mounts have manual slow-motion controls on both axes. Drive motors are often standard items on the east-west, or right ascension, axis, but adding push-button motion to the north-south, or declination, axis of some telescopes requires replacing the manual slow motion with an optional declination motor. Sometimes available from the original manufacturer or, alternatively, from third-party suppliers, Dec. motors are nice for visual use and almost essential for guiding astro-photos.

Dobsonian drive systems (\$500 to \$1,500)

Owners of Dobsonian-mounted telescopes can add tracking capability to their no-frills scopes via a number of routes. Kits are available that add electric motors to both axes that you then manually adjust in speed to keep objects centered. Computerized dual-axis motor kits are also coming out that perform the necessary speed adjustments for you. Another approach is the equatorial platform, a swiveling motorized base that can provide up to an hour of tracking before needing to be reset.

Domes and shelters (\$500 on up)

The ultimate accessory is a permanent home for your telescope. You can purchase dome kits to fashion your own backyard observatory. Or, if you wish to remain mobile, some manufacturers offer portable tentlike shelters that serve as your dome-away-from-home.

That Added Pizzaz

Digital setting circles (\$400 to \$800)

These nifty black boxes read pulses from optical encoders you install on the axes of your telescope (kits are available

for all types of telescopes, including Dobsonians). After you initially sight two known stars, the readouts can tell you where your telescope is pointed and guide you to the locations of objects programmed into the on-board memory chips. (You watch coordinate numbers count down to zero as you manually slew the telescope to your target.) Many of the units from various manufacturers are similar, differing mostly in the size of their database. All can make finding objects a snap, opening up the realm of deep-sky observing to those that might have otherwise fear to dive in.

Computer interfaces (\$100 to \$300)

Some telescopes, such as Meade's LX-200 series, go one step further by offering high-speed motors that slew the telescope for you. At yet another level of technical innovation, you can now also connect these telescopes to a computer (a laptop is ideal) running one of the sophisticated star charting programs now available. Point your mouse at an object on the screen, click on it, and away your scope goes in search of your target.

Camera adapters (\$25 to \$50)

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Telescope Eyepieces

Brand	Series	Focal Length	Apparent FOV (°)	Coatings	Eye Relief (mm)	Eyecups	Parfocal	Retail
Standard Field of View — 1.25-inch Barrel (cont.)								
Orion	Orthoscopic	7	44	MC	6	—	✓	\$55
Orion	Orthoscopic	5	44	MC	5	—	✓	\$55
Orion	Sirius Plössl	40	43	C	n/a	—	✓	\$80
Orion	Sirius Plössl	25	50	C	20	—	✓	\$60
Orion	Sirius Plössl	17	50	C	13	—	✓	\$60
Orion	Sirius Plössl	10	50	C	8	—	✓	\$60
Orion	Sirius Plössl	7.5	50	C	6	—	✓	\$60
Orion	Ultrascope	35	52	FMC	25	—	—	\$100
Orion	Ultrascope	30	52	FMC	21	—	✓	\$95
Orion	Ultrascope	25	52	FMC	17	—	✓	\$90
Orion	Ultrascope	20	52	FMC	13	—	✓	\$75
Orion	Ultrascope	15	52	FMC	10	—	✓	\$75
Orion	Ultrascope	10	52	FMC	6	—	✓	\$75
Orion	Ultrascope	7.5	52	FMC	5	—	✓	\$75
Orion	Ultrascope	5	52	FMC	8	—	✓	\$85
Orion	Ultrascope	3.8	52	FMC	6	—	✓	\$85
Parks	Kellner	40	32	MC	n/a	—	—	\$45
Parks	Kellner	25	42	MC	n/a	—	—	\$45
Parks	Kellner	12	42	MC	n/a	—	—	\$45
Parks	Kellner	6	42	MC	n/a	—	—	\$45
Parks	Gold Plössl	35	50	MC	25	—	—	\$163
Parks	Gold Plössl	30	52	MC	21	—	✓	\$130
Parks	Gold Plössl	25	52	MC	17	—	✓	\$98
Parks	Gold Plössl	20	52	MC	13	—	✓	\$98
Parks	Gold Plössl	15	52	MC	10	—	✓	\$91
Parks	Gold Plössl	10	52	MC	6	—	✓	\$91
Parks	Gold Plössl	7.5	52	MC	5	—	✓	\$91
Parks	Gold Plössl	5	52	MC	8	—	✓	\$156
Parks	Gold Plössl	3.8	52	MC	6	—	✓	\$156
Takahashi	LE-MC	30	50	FMC	20	✓	✓	\$169
Takahashi	LE-MC	24	50	FMC	17	✓	✓	\$148
Takahashi	LE-MC	18	50	FMC	13	✓	✓	\$148
Takahashi	LE-MC	12.5	50	FMC	9	✓	✓	\$148
Takahashi	LE-ED/MC	7.5	50	FMC	10	✓	✓	\$159
Takahashi	LE-ED/MC	5	50	FMC	10	✓	✓	\$159
Tele Vue	Plössl	40	43	FMC	28	✓	—	\$107
Tele Vue	Plössl	32	50	FMC	22	✓	✓	\$107
Tele Vue	Plössl	26	50	FMC	18	✓	✓	\$80
Tele Vue	Plössl	21	50	FMC	14	✓	✓	\$80
Tele Vue	Plössl	17	50	FMC	12	✓	✓	\$80
Tele Vue	Plössl	13	50	FMC	9	✓	✓	\$80
Tele Vue	Plössl	10.5	50	FMC	7	✓	✓	\$80
Tele Vue	Plössl	7.4	50	FMC	5	✓	✓	\$80
Tuthill	Orthoscopic	25	n/a	C	n/a	—	✓	\$65
Tuthill	Orthoscopic	18	n/a	C	n/a	—	✓	\$65
Tuthill	Orthoscopic	12.5	n/a	C	n/a	—	✓	\$65
Tuthill	Orthoscopic	9	n/a	C	n/a	—	✓	\$65
Tuthill	Orthoscopic	7	n/a	C	n/a	—	✓	\$65
Tuthill	Orthoscopic	6	n/a	C	n/a	—	✓	\$65
Tuthill	Orthoscopic	5	n/a	C	n/a	—	✓	\$65
Tuthill	Orthoscopic	4	n/a	C	n/a	—	✓	\$65
Tuthill	Plössl	35	45	MC	25	—	✓	\$105
Tuthill	Plössl	30	50	MC	21	—	✓	\$89
Tuthill	Plössl	25	50	MC	17	—	✓	\$79
Tuthill	Plössl	20	50	MC	13	—	✓	\$79
Tuthill	Plössl	15	50	MC	10	—	✓	\$79
Tuthill	Plössl	10	50	MC	6	—	✓	\$79
Tuthill	Plössl	7.5	50	MC	5	—	✓	\$79
Tuthill	Plössl	5	50	MC	n/a	—	✓	\$79
University	König II	32	52	FMC	n/a	—	—	\$110
University	Plössl	20	50	MC	n/a	—	—	\$50
University	Plössl	12	50	MC	n/a	—	—	\$50
University	Plössl	7	50	MC	n/a	—	—	\$50
VernonScope	Brandon	32	50	C	26	✓	✓	\$125
VernonScope	Brandon	24	50	C	19	✓	✓	\$125
VernonScope	Brandon	16	50	C	13	✓	✓	\$125
VernonScope	Brandon	12	50	C	10	✓	✓	\$125
VernonScope	Brandon	8	50	C	6	✓	✓	\$125

Standard Field of View — 2-inch Barrel

Celestron	Ultima	80.0	34	FMC	50	✓	—	\$299
Celestron	Ultima	60.0	45	FMC	39	✓	—	\$229

(continued on page 48)



AN UPGRADED FINDERSCOPE

such as an 8x50 will reveal many deep-sky objects in the finder. Many amateurs prefer a Telrad finder, shown here, because it allows them to locate objects without magnification.

35mm camera body to a telescope, opening up the realm of astrophotography. (An equatorial mount and clock drive are a must.) A prime focus adapter allows you to take pictures of the Moon and Sun. High-magnification pictures of the planets require an eyepiece projection adapter, sometimes called a tele-extender. Clamp your camera with its lens to the side of your telescope with a piggyback bracket and you can take time exposure photos of starfields and constellations.

Guiding accessories (\$80 to \$900)

Close-up photos of nebulae require long time exposures through a telescope. Unfortunately you cannot let a telescope track by itself during such exposures because minor errors in the drive system will produce an image with stars wiggling all over the field. Manually guiding a telescope minimizes tracking errors but requires either an off-axis guider (\$80 to \$400) or a separate guidescope such as a 60mm or 80mm refractor (\$160 to \$400). Either way, you will also need a guiding eyepiece (\$80 to \$200) with an illuminated reticle so you can monitor the position of a guide star during the exposure. Astrophotographers can now purchase autoguider (\$900) that monitor motions using a light-sensitive CCD chip and automatically pulse the drive motors to keep the scope precisely on target.

CCD cameras (\$400 to \$5,000 plus personal computer)

These electronic cameras can capture images of faint celestial objects with shorter exposure times than ordinary film can. They have narrow fields of view but are well suited to imaging the planets, small nebulae, and galaxies. CCD cameras require a well-equipped computer for storing and processing images — a typical CCD setup is not for someone “technically challenged!” But if you want to be at the cutting edge of amateur astronomy, CCD imaging is there.

Where to Buy Accessories

ACCESSORY MANUFACTURERS BY PRODUCT

(Manufacturer information on page 49)

Accessory trays for tripods

DDS Astronomical Products; Tekton Industries

Aluminizing/mirror coating services

Aluminum Coating; Denton Vacuum; Evaporated Metal Films; Optical Coating Laboratory; P.A. Clausing; P.A.P. Coating Services; QSP Optical Technology; Top Coat Vacuum Depositions; Vapor Coat

Anti-dew accessories

Astronomical Innovations; Celestron; Jim Kendrick Studio; Meade; Orion; Roger W. Tuthill; Space Technologies and Research

Astrophoto accessories — cameras

Sky Scientific; Taurus Technologies; Northern Lites

Astrophoto accessories — camera adapters

Astro-Physics; Celestron; Kenneth Novak; Lumicon; Meade; Optica b/c; Orion; Parks Optical; Tele Vue; University Optics

Astrophoto accessories — camera tracking platforms

Astro Kits; Distar USA; Edward R. Byers; Vista Instrument

Astrophoto accessories — field flatteners/focal reducers

Astro-Physics; Celestron; Lumicon; Meade; Orion

Astrophoto accessories — focusing aids

Beattie Systems; Celestron; P&S Skyproducts; Spectra Astro Systems; Stellar Products (adaptive optics unit)

Astrophoto accessories — guiding accessories

Astro-Physics; Celestron; Hollywood General Machining; Lumicon; Meade; Orion; Santa Barbara Instrument Group (SBIG); Spectra Astro Systems; University Optics; Versacorp

Barlow lenses

Astro-Physics; Celestron; Edmund Scientific; Meade; Orion; Parks Optical; Tele Vue; University Optics; VERNONscope

Binocular stands and tripod adapters

Astronomical Innovations; Celestial Innovations; Celestron; Edmund Scientific; Grandview Instruments; Innovative Energies; Orion; Parks Optical; Safari Telescopes; Star Bound; Vista Instrument

Cases and covers

Astronomical Innovations; Billingham Bags; Celestron; Coast Manufacturing; Domke; Daskocil Manufacturing; f.64; Fotima USA; Galen Rowell Bags; Golden East; Lightware; LowePro USA; MC Photographic; Meade; Orion; Pelican Products; Porter Case; Tamrac; Tenba; The

Cosmic Factory; Tundra Packs; Wells Cargo (telescope trailers); Zero Halliburton

CCD cameras and accessories

Astro-Link; CCD Technology; CompuScope; Cryolume Int'l; Electrim Corp.; First Magnitude Corp.; Galactic Images; J&R Engineering Assoc.; Meade; Micro Luminetics; Murnaghan; OPTEC; Photometrics; Roger W. Tuthill; Saguaro Scientific Corp.; Santa Barbara Instrument Group (SBIG); Sirius Instruments; Southwest Cryostatics; SpectraSource Instruments; Starlit Technology; University Optics; Western Research Company

Chairs (for observing)

Architectural Arts; Astronomical Innovations; K.C. Woodsmith; Orion; Star Bound; Tele Vue; Vista Instrument

Cleaning supplies for optics

Brite Sky; Orion; Thaural Research

Clothing (outdoor)

Damart; Jan's Custom Knits; Tempo Glove Mfg. Inc.

Collimation aids

Astronomical Innovations; AstroSystems; Kensington Optics; Tectron

Coma correctors

Celestron; Lumicon; Tele Vue

Computer-to-telescope interfaces

Applied Controls Technology; Jefden Designs; Meade; Quadrant Systems

Counterweights

Celestron; Hollywood General Machining; Meade; Orion

Declination motors

Celestron; Davionix; Jim's Mobile Industries (JMI); Lumicon; Meade; Orion

Digital setting circles

Celestron; Jim's Mobile Industries (JMI); Lumicon; Meade; Opto-Data; Orion; Quadrant Systems; Roger W. Tuthill; SkyComm Engineering; Tele Vue

Dobsonian drive systems

Equatorial Platforms; Mountain Instruments; Soft-Tec Systems; TECH2000

Domes and shelters

Ace Dome; Ash Manufacturing; Observa-Dome Laboratories; Sarda Industries; Stewart Research Enterprises; Technical Innovations

Eyepieces

Adorama; Astronomical Innovations; Celestron; Clavé (see Roger W. Tuthill and S&S Optika); Edmund Scientific; Masugama (see R.V.R. Optical); Meade; Japanopik (see Roger W. Tuthill and S&S Optika); Orion; Parks Optical; Roger W. Tuthill; Takahashi (see Land, Sea, and Sky); Tele Vue; University Optics; VERNONscope; Vixen (see Celestron); Zeiss (see VERNONscope)

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Standard Field of View — 2-inch Barrel (cont.)								
Celestron	Ultima	45.0	50	FMC	32	✓	—	\$219
Clavé	Plössl	65.0	40	FMC	n/a	—	✓	\$445
Clavé	Plössl	55.0	45	FMC	n/a	—	✓	\$445
Clavé	Plössl	45.0	50	FMC	n/a	—	✓	\$445
Clavé	Plössl	40.0	50	FMC	n/a	—	✓	\$445
Clavé	Plössl	35.0	50	FMC	n/a	—	✓	\$415
Clavé	Plössl	30.0	50	FMC	n/a	—	✓	\$415
Masuyama	Masuyama	80.0	34	FMC	n/a	—	✓	n/a
Masuyama	Masuyama	60.0	46	FMC	n/a	—	✓	n/a
Masuyama	Masuyama	45.0	50	FMC	n/a	—	✓	n/a
Meade	4000 Plössl	56.0	52	FMC	47	✓	—	\$230
Orion	Plössl	50.0	50	MC	20	—	—	\$100
Parks	Plössl	50.0	51	MC	n/a	—	—	\$150
Takahashi	LE-50 MC	50.0	50	FMC	n/a	✓	—	\$330
Tele Vue	Plössl	55.0	50	FMC	38	✓	—	\$220
University	Plössl	55.0	50	FMC	n/a	—	—	\$120
VernonScope	Brandon	48.0	50	C	38	✓	✓	\$295
Wide Angle — 1.25-inch Barrel								
Japanoptik	WideVue	25	65	FMC	n/a	—	✓	n/a
Japanoptik	WideVue	17	65	FMC	n/a	—	✓	n/a
Japanoptik	WideVue	12	65	FMC	n/a	—	✓	n/a
Japanoptik	WideVue	9	65	FMC	n/a	—	✓	n/a
Japanoptik	WideVue	7	65	FMC	n/a	—	✓	n/a
Masuyama	Masuyama	25	65	FMC	n/a	—	✓	n/a
Meade	4000 Super Wide	24.5	67	FMC	19	✓	✓	\$200
Meade	4000 Super Wide	18	67	FMC	14	✓	✓	\$170
Meade	4000 Super Wide	13.8	67	FMC	10	✓	✓	\$160
Orion	MegaVista	16.8	67	FMC	16	✓	✓	\$160
Orion	MegaVista	10.5	67	FMC	13	✓	✓	\$160
Tele Vue	Wide-Field	19	65	FMC	11	✓	✓	\$150
Tele Vue	Wide-Field	15	65	FMC	9	✓	✓	\$140
Tele Vue	Panoptic (1.25/2")	22	68	FMC	16	✓	✓	\$250
Tele Vue	Panoptic	15	68	FMC	10	✓	✓	\$200
University	König II	24	60	FMC	n/a	—	—	\$75
University	König II	16	65	FMC	n/a	—	—	\$75
University	König II	12	60	FMC	n/a	—	—	\$75
University	König II	8	60	FMC	n/a	—	—	\$75
University	König II	6.5	65	FMC	n/a	—	—	\$75
Wide Angle — 2-inch Barrel								
Celestron	Vixen LV	30	60	FMC	20	✓	✓	\$160
Japanoptik	WideVue	32	65	FMC	n/a	—	✓	n/a
Meade	4000 Super Wide	40	67	FMC	27	✓	—	\$340
Meade	4000 Super Wide	32	67	FMC	20	✓	—	\$280
Orion	Erfile	32	65	MC	42	—	—	\$109
Orion	MegaVista	40	70	FMC	23	✓	—	\$230
Orion	MegaVista	34	70	FMC	19	✓	—	\$210
Parks	Erfile	32	65	MC	n/a	—	—	\$150
Tele Vue	Wide-Field	32	65	FMC	19	✓	✓	\$240
Tele Vue	Panoptic	35	68	FMC	25	✓	✓	\$325
Tele Vue	Panoptic	27	68	FMC	18	✓	✓	\$300
University	König II	40	60	FMC	n/a	—	—	\$125
University	König II 7/70	40	70	FMC	23	✓	—	\$250
University	König II	32	60	FMC	n/a	—	—	\$125
VernonScope	König	32	60	C	19	—	—	\$185
Extra Wide Angle — 1.25-inch Barrel								
Meade	4000 Ultra Wide	6.7	84	FMC	11	✓	✓	\$220
Meade	4000 Ultra Wide	4.7	84	FMC	7	✓	✓	\$180

(continued on page 50)

Filters — Nebula

Celestron; DayStar Filter Corp.; Lumicon; Meade; Orion; Parks Optical

Filters — Planetary

Celestron; Cole Enterprises; Meade; Optica b/c; Orion; Parks Optical; University Optics; VERNONscope

Filters — Solar

AbelExpress; Astro-Physics; Astronomical Innovations; Celestron; DayStar Filter Corp.; Edwin Hirsch; J.M.B.; Lumicon; Orion; Rainbow Symphony; Roger W. Tuthill; Tele Vue; Thousand Oaks Optical

Finderscopes and reflex sights

Astro-Physics; Celestron; Lumicon; Meade; Orion; Parks Optical; Rigel Systems; Roger W. Tuthill; S.B. Kufeld (Telrad); Tele Vue; University Optics

Flashlights — astronomical

AstroSystems; C.O.S.; Celestron; Fleming Flashlights; LEDtronics; Liston Concepts; Noctilume; Omniseal; Orion; R.E. Adams Electronics; Rigel Systems; Talmadge Engineering

Focus motors

Celestron; Jim's Mobile Industries (JMI); Meade; Orion

Inverters and drive correctors

Celestron; Davionix; Jim's Mobile Industries (JMI); Lumicon; Meade; Orion; Vista Instrument; Vogel Enterprises

Mirrors and lenses (for homemade telescopes)

AXE; Ceravolo Optical Systems; Clear Star Optics; Coulter Optical; Custom Optical Fabrication; D&G Optical; E&W Optical; Edmund Scientific; Enterprise Optics; Galaxy Optics; Iowa Scientific Optical; Lorraine Precision Optics; Meade; Nova Optical Systems; Optical Glass Fabrication; Orion; Parks Optical; Pegasus Optics; Precision Applied Products; Precision Lenses; Star Instruments; Starstorm Optical; Stellar Optics; Torus Optical Works; University Optics

Power packs

Orion; Roger W. Tuthill; plus many scope dealers

Star diagonals

Celestron; Lumicon; Meade; Orion; Parks Optical; Tele Vue; VERNONscope

Telescope- and mirror-making supplies

Astronomical Innovations; AstroSystems; Carlino Woodcraft; Cosmos Ltd.; Crazy Ed Optical; Cusick Telescopes; Denny's Astro Mart; Edmund Scientific; Great Plains Instruments; Hydro-Abrasive Machining; Jim's Mobile Industries (JMI); KB Systems; Kenneth Novak; Lumicon; Meade; Newport Industrial Glass; Ohara Corporation; Optica b/c; Orion; Palomar Optical Supply; Parallax Instruments; Parks Optical; Salem Distributing; Tectron; TELSTAR; United Lens; University Optics

Vibration dampeners

Celestron; Hollywood General Machining

ADDRESSES BY MANUFACTURER

AbelExpress, 230 E. Main St., Carnegie, PA 15106.
Ace Dome, 3186 Juanita, Las Vegas, NV 89102,
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Aluminum Coating, 807 Rutherford, San Carlos,
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Applied Controls Technology, 8059 Lochdale,
Dearborn, MI 48127, (313) 563-6652.
Architectural Arts, 1903 Appianway Dr., Little
Rock, AR 72204.
Ash Manufacturing Co. Inc., Box 312, Plainfield, IL
60544, (815) 436-9403.
Astro Kits, 824 Bronx River Rd., Bronxville, NY
10708, (914) 776-1931.
Astro-Link, P.O. Box 1978, Spring Valley, CA
92077, (619) 449-4722.
Astronomical Innovations, P.O. Box 14853,
Lenexa, KS 66285, (913) 894-5775.
Astro-Physics, 11250 Forest Hills Rd., Rockford,
IL 61111, (815) 282-1513.
AstroSystems, Inc., 5348 Ocotillo Ct., Johnstown,
CO 80534, (303) 587-5838.
AXE, 5712 E. Cooper St., Tucson, AZ 85711, (602)
790-1452.
Beattie Systems, Inc., P.O. Box 3142, Cleveland,
TN 37311.
Billingham Bags, c/o Aetna Optix, Inc., P.O. Box
268, Island Park, NY 11558, (516) 889-8570.
Brite Sky, 5B First St., Dover, NH 03820, (603)
743-4083.
C.O.S., 7354 Sand Hill Rd., Akron, NY 14001,
(716) 542-3859.
Carlino Woodcraft, 7118 Kinne Rd., Lockport, NY
14094, (716) 433-3432.
CCD Technology, 18092 Sky Park, South Unit E,
Irvine, CA 92714, (714) 752-2442.
Celestial Innovations, H.C.R. Box 3228, Oracle, AZ
85623, (602) 896-9109.
Celestron International, 2835 Columbia St.,
Torrance, CA 90503, (310) 328-9560.
Cervolo Optical Systems, P.O. Box 1427,
Ogdensburg, NY 13669, (613) 258-4480.
Clear Star Optics, 4193 Tallmadge Rd.,
Roslindale, OH 44272, (216) 325-1722.
Coast Manufacturing Co., 200 Corporate Blvd.
South, Yonkers, NY 10701, (914) 376-1500.
Cole Enterprises, P.O. Box 3235, Hemet, CA
92343, (714) 654-8991.
CompuScope, 3463 State St., Suite 431, Santa
Barbara, CA 93105, (805) 966-7179.
Cosmic Factory, The, P.O. Box 98, Forestdale, RI
02824, (401) 737-1209.
Cosmos Ltd., 9215 Waukegan Rd., Morton Grove,
IL 60053, (708) 827-4846.
Coulter Optical, P.O. Box K, Idyllwild, CA 92549,
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Crazy Ed Optical, P.O. Box 110566, Campbell, CA
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Cryolume International, 2139 North University
Drive, Coral Springs, FL 33071, (305) 720-
5310.
Cusick Telescopes, P.O. Box 256, Buena Vista, CO
81211, (719) 395-8253.
Custom Optical Fabrication, 4994 South 300
West, Salt Lake City, UT 84107, (801) 266-
8738.
D&G Optical, 6490 Lemon St., East Petersburg,
PA 17520, (717) 560-1519.
Damart, 3 Front St., Dept. 0A640, Rollinsford, NH
03805.
Davionix, 3535 Shafer Dr., Santa Clara, CA 95051,
(408) 244-4660.
DayStar Filter Corporation, P.O. Box 1290,
Pomona, CA 91769, (714) 591-4673.

DDS Astronomical Products, 240 Belmont
Avenue, Long Beach, CA 90803, (310) 433-
9745.
Denny's Astro Mart, 832 Sidney Baker, Kerrville,
TX, 78028, (512) 896-6377.
Denton Vacuum Inc., Cherry Hill Industrial Center,
Cherry Hill, NJ 08003.
Distar (USA) Inc., P.O. Box 273, Yonkers, NY
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Dorskil Manufacturing Co., Inc., P.O. Box 1246,
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Edmund Scientific, 100 East Gloucester Pike,
Barrington, NJ 08007, (609) 547-3488.
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Enterprise Optics, P.O. Box 413, Dept. A,
Placentia, CA 92670, (714) 524-7520.
Equatorial Platforms, 11065 Peaceful Valley Rd.,
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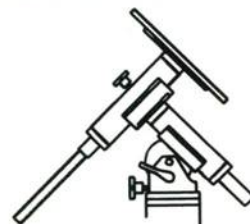
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Brand	Series	Focal Length	Apparent FOV (°)	Coatings	Eye Relief (mm)	Eyecups	Parfocal	Retail
Extra Wide Angle — 1.25-inch Barrel (cont.)								
Tele Vue	Nagler	7	82	FMC	10	✓	✓	\$190
Tele Vue	Nagler	4.8	82	FMC	6	✓	✓	\$150
University	Wide Scan	20	82	FMC	n/a	✓	—	\$150
University	Wide Scan	16	82	FMC	17	✓	—	\$140
University	Wide Scan	13	84	FMC	n/a	✓	—	\$120
University	Wide Scan	10	84	FMC	7	✓	—	\$110
Extra Wide Angle — Dual 1.25/2-inch Barrel								
Meade	4000 Ultra Wide	14	84	FMC	23	✓	—	\$330
Meade	4000 Ultra Wide	8.8	84	FMC	16	✓	✓	\$270
Tele Vue	Nagler II	16	82	FMC	10	✓	✓	\$290
Tele Vue	Nagler	13	82	FMC	18	✓	✓	\$250
Tele Vue	Nagler II	12	82	FMC	11	✓	✓	\$250
Tele Vue	Nagler	9	82	FMC	12	✓	✓	\$220
Extra Wide Angle — 2-inch Barrel								
Tele Vue	Nagler II	20	82	FMC	12	✓	✓	\$340
University	Wide Scan	32	84	FMC	20	✓	—	\$250
Key								
Series	Generic optical design or manufacturer's brand name.							
Focal length	Focus in millimeters.							
Apparent FOV	Apparent field of view (in degrees).							
Coatings	Type of optical coatings. C = single-layer; MC = some surfaces multicoated; FMC = all surfaces multicoated.							
Eye Relief	Distance your eye needs to be above the eyepiece to see the entire field (in millimeters).							
Eyecups	Unit has rubber eyecups for blocking stray light.							
Parfocal	Unit focuses at the same point as other eyepieces in the series.							
Retail	Typical retail price, or suggested retail price as supplied by manufacturer. Actual prices at dealers may vary.							

TELSTAR, 2130 Primate Rd., Mississauga, Ontario, Canada L4Y 1V4, (416) 277-1708.
 Tempo Glove Mfg. Inc., 3820 W. Wisconsin Ave., Milwaukee WI 53208.
 Tenba, 503 Brd.way, New York, NY 10012, (212) 966-1013.
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 Thousand Oaks Optical, Box 5044-289, Dept. A, Thousand Oaks, CA 91359, (805) 491-3642.
 Top Coat Vacuum Depositions, 26 Eastern Avenue, Amherst, NH 03031, (603) 672-5617.
 Torus Optical Works, 67 Bon-Aire, Iowa City, IA 52240, (319) 339-0524.
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 VERNONscope, 5 Ithaca Rd., P.O. Box 105, Candor, NY 13743, (607) 659-7000.
 Versacorp, P.O. Box 7, Sun City, AZ 85372, (602) 876-8344.
 Vista Instrument Co., 307 E. Tunnell St., P.O. Box 1919, Santa Maria, CA 93454, (805) 925-1240.
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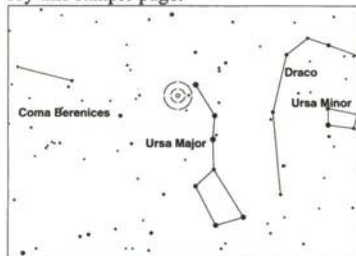
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M51

M51

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NGC	TYPE	MAG.	DISTANCE	SIZE	DIAMETER
5194	Sp	8.1	35,000,000 Ly.	11" x 8"	112,000 Ly.

From *The Messier Objects*. Books measure 5.5" X 8.5".

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5".....135.00	5".....115.00
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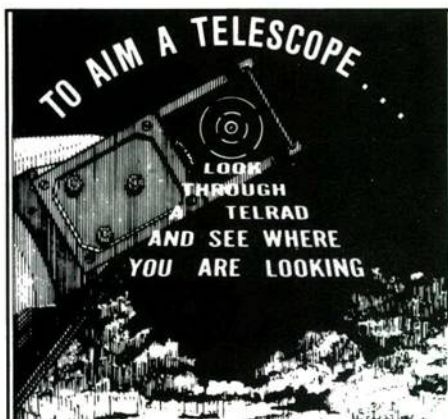
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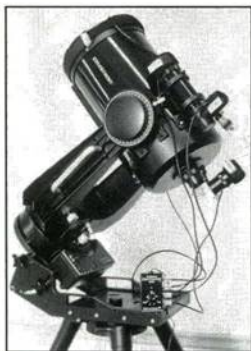
To put a bright object in the telescope, look through the Telrad® and move the telescope until the rings are centered on the object. A faint object in the void between stars is first located on star charts. Note its position among the visible stars, then set the Telrad® rings on the same spot in the sky.



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Buying Binoculars

They are the forgotten optics of the hobby. Bypassed by beginners drawn to high-powered telescopes, binoculars are in fact ideal starter instruments for backyard astronomers.



You may already own some. Or for no more than \$100 you can buy a pair that will reveal galaxies millions of light years away, rich star-packed fields along the Milky Way, bright star clusters and nebulae, moons orbiting Jupiter, and craters on the surface of the Moon. Binoculars are the one instrument everyone with an interest in astronomy owns, or should own. Even avid amateurs with a houseful of telescopes will have one or more pairs of binoculars at the ready. They know that binoculars provide something no telescope can — a wonderful wide field of view in a package that requires no more effort to use than simply lifting them to the eyes.

In fact binoculars provide unexcelled views of objects such as the Andromeda Galaxy, the Pleiades star cluster, the nebula-rich regions of Sagittarius, earthshine on the Moon, groupings of planets, lunar and solar eclipses — the list is long enough that you never outgrow the need for binoculars.

Yet despite years of having amateurs extoll the virtues of binoculars, few beginners realize the merit of starting with these affordable and handy instruments. The best binoculars for astronomy may be the pair you already own, stuffed away in your closet and pulled out only for ball games.

But if you are shopping for a new pair, here's what to look for.

Optical Features

Aperture

As with telescopes, the most important specification of binoculars is the diameter of the front lenses. For binoculars intended for daytime use, when lots of light is available, aperture isn't so critical. Binoculars with 35mm or even 20mm-aperture lenses can work well in the daytime. But for astronomy, as for any nighttime use, binoculars with at least 40mm to 50mm lenses are best.

To determine the aperture, look for a number such as 7x50. The last number, the "50" in this case, is the aperture in millimeters. The larger this number, in general, the brighter the images will appear. The tradeoff is that the bigger the aperture, the bigger, heavier, and more expensive the binocular.

Magnification

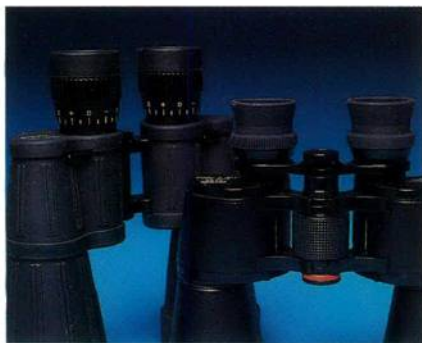
In a designation such as 7x50, the first number is the magnification. Binoculars come in models with magnifications from 6x to about 20x. But again,

Binoculars for Astronomy

Manufacturer	Model	Actual FOV (°)	Apparent FOV (°)	Eye Relief (mm)	Coatings	Prism Type	Focus Type	Roll Down Cups	Tripod Socket	Armored	Water-proof	Case	Warranty (years)	Weight (oz.)	Retail*
7x42 MODELS															
Vivitar	Series 1	6.4	45	18	FMC	BaK4	CF	✓	—	✓	—	SV	30	22	\$150
Carton	Adlerblick	6.5	46	22	FMC	BaK4	CF	✓	✓	partial	—	HV	20	21	\$180
Fujinon	Series 4000 DCF	6.5	46	21	MC	Roof	CF	✓	✓	—	—	incl.	Life	19	\$190
Tasco	Futura LE	7.0	49	18	C	BK7	CF	✓	—	✓	—	SV	Life	22	\$216
Celestron	Ultima	7.0	49	23	FMC	BaK4	CF	✓	✓	partial	—	HV	Life	20	\$229
Simmons	Euro-Platinum	6.4	45	5	MC	BK7	CF	✓	—	✓	—	SV	Life	22	\$230
Unitron	Pro	6.6	46	n/a	MC	BaK4	CF	✓	✓	—	—	incl.	25	22	\$285
Brunton	Eterna	9.4	66	22	FMC	BaK4	CF	✓	✓	✓	✓	SV	Life	28	\$349
Mirador	ZCFY-Series	6.6	46	22	MC	BaK4	CF	✓	✓	—	—	HV	Life	22	\$378
Swift	Ultralite ZCF	6.5	46	17	MC	BaK4	CF	✓	✓	partial	—	SV	Life	20	\$390
Optolyth	Alpin	6.6	46	16	FMC	BaK4	CF	✓	—	✓	—	SL	30	17	\$460
Swarovski	Traditional	6.5	46	12	FMC	BaK4	CF	✓	—	option	✓	—	Life	23	\$527
Optolyth	Touring	8.0	56	10	FMC	Roof	CF	✓	—	✓	—	SL	30	30	\$730
Swarovski	SLC	8.0	56	n/a	FMC	Roof	CF	✓	✓	✓	✓	—	Life	31	\$943
Zeiss	B/GA T* Dialyt	8.6	60	18	FMC	Roof	CF	✓	—	✓	✓	SL	30	28	\$1,215
Leica	BA Ultra	8.0	56	17	FMC	Roof	CF	✓	—	✓	✓	SL	Life	31	\$1,299
8x42 MODELS															
Orion	WA Ultraview	8.2	66	22	FMC	BaK4	CF	✓	✓	✓	—	HV	10	27	\$148
Carton	Adlerblick	6.3	50	18	FMC	BaK4	CF	✓	✓	partial	—	HV	20	21	\$180
Orion	Vista	6.5	52	18	FMC	BaK4	CF	✓	✓	—	—	HV	20	22	\$197
Bushnell	Spectator	6.5	52	12	C	Roof	CF	✓	—	✓	—	incl.	Life	22	\$200
Parks	DCF	6.5	52	n/a	MC	Roof	CF	✓	—	✓	—	SV	Life	n/a	\$270
Unitron	Pro	6.3	50	n/a	MC	BaK4	CF	✓	✓	—	—	incl.	25	n/a	\$285
Swift	Hawk HCF	6.5	52	16	MC	Roof	CF	✓	—	✓	—	SV	Life	18	\$335
Mirador	ZCFY-Series	6.3	50	16	MC	BaK4	CF	✓	✓	—	—	HV	Life	22	\$396
Swift	Ultralite ZCF	6.3	50	16	MC	BaK4	CF	✓	✓	partial	—	SV	Life	20	\$398
Pentax	DCF HR	6.2	50	22	FMC	Roof	CF	✓	✓	✓	✓	SL	Life	26	\$440
Bausch&Lomb	PC Elite RA	7.0	56	18	FMC	Roof	CF	✓	—	✓	—	incl.	Life	30	\$920
Leica	BA Ultra	7.4	59	16	FMC	Roof	CF	✓	—	✓	✓	SL	Life	31	\$1,299
OTHER 40mm-CLASS MODELS															
Swift	8.5x44 Audubon	8.2	70	12	MC	BaK4	CF	✓	✓	—	—	SV	Life	21	\$475
Celestron	6.5x44 ED Series	7.3	47	20	FMC	BaK4	CF	✓	✓	✓	—	SV	Life	26	\$499
Celestron	9.5x44 ED Series	6.0	57	18	FMC	BaK4	CF	✓	✓	✓	—	SV	Life	26	\$499
Swift	8.5x44 ED Audubon	8.2	70	12	FMC	BaK4	CF	✓	✓	—	partial	SV	Life	n/a	\$940
Zeiss	7x45B Design Select	8.6	60	n/a	FMC	Roof	CF	✓	—	✓	✓	SL	30	41	\$1,410
7x50 MODELS															
Simmons	Red Line	7.0	49	5	C	BK7	CF	✓	—	—	—	SV	Life	25	\$72
Simmons	Euro-Gold	7.0	49	5	C	BK7	CF	✓	—	✓	—	SV	Life	29	\$90
Celestron	Nature	6.8	48	18	C	BK7	CF	✓	✓	✓	—	SV	Life	25	\$99
Swift	Aerolite ZCF	7.1	50	14	C	BK7	CF	✓	—	—	—	SV	5	38	\$99
Unitron	Unifocus	6.2	43	14	C	BK7	CF	✓	—	—	—	HV	25	24	\$105
Tasco	Standard	7.0	49	n/a	C	BK7	CF	✓	—	—	—	—	Life	27	\$107
Simmons	Armored Black	6.8	48	5	C	BK7	CF	✓	—	✓	—	SV	Life	25	\$113
Orion	Explorer	6.8	48	14	MC	BaK4	CF	✓	—	partial	—	HV	5	25	\$117
Bushnell	Ensign	7.0	49	n/a	C	BK7	CF	✓	—	✓	—	SV	Life	29	\$120
Nikon	Stayfocus Plus II	6.2	43	16	MC	BaK4	CF	✓	—	partial	—	incl.	25	35	\$130
Simmons	Euro-Platinum	7.1	50	5	MC	BK7	CF	✓	—	✓	—	SV	Life	30	\$130
Parks	GR	7.1	50	n/a	MC	BK7	CF	✓	✓	✓	—	HV	Life	n/a	\$140
Swift	Swift Focus	8.0	56	17	C	BK7	CF	✓	—	✓	—	SV	5	32	\$144
Simmons	Armored Yellow	6.5	46	5	C	BK7	CF	✓	—	✓	—	HV	Life	28	\$147
Celestron	Pro	7.1	50	23	FMC	BaK4	CF	✓	✓	✓	—	HV	Life	29	\$149
Orion	Ultraview	6.5	46	23	FMC	BaK4	CF	✓	✓	✓	—	HV	10	32	\$159
Unitron	High Eyepoint	6.8	48	14	C	BK7	CF	✓	—	partial	—	HV	25	25	\$165
Tasco	Armored	7.0	49	n/a	C	BK7	CF	✓	—	✓	—	—	Life	33	\$170
Mirador	BCF Series	7.2	n/a	n/a	C	BaK4	CF	✓	✓	—	—	HV	Life	25	\$171
Unitron	Armored	6.5	46	15	C	BK7	CF	✓	✓	partial	—	HV	25	26	\$175
Vivitar	Series 1	7.1	50	15	FMC	BaK4	CF	✓	✓	✓	✓	SV	30	27	\$180
Swift	Dolphin ZCF	6.8	48	17	C	BK7	CF	✓	✓	partial	—	SV	Life	29	\$208
Orion	Vista	6.0	42	n/a	FMC	BaK4	CF	✓	✓	—	—	HV	20	28	\$219
Tasco	Futura LE	6.8	48	14	C	BK7	CF	✓	—	✓	—	SV	Life	25	\$226
Pentax	PCF II	7.1	50	20	FMC	BaK4	CF	✓	✓	✓	—	SL	Life	32	\$244
Minolta	XL Standard	7.8	55	16	MC	BaK4	CF	✓	✓	✓	—	HV	25	35	\$251
Celestron	Ultima	7.0	49	20	FMC	BaK4	CF	✓	✓	partial	—	HV	Life	27	\$269
Fujinon	AR Nautilus	7.5	53	16	FMC	BaK4	IF	✓	✓	✓	✓	—	Life	46	\$275
Carton	MC Adlerblick	6.8	48	19	FMC	BaK4	CF	✓	✓	partial	—	HV	20	27	\$280

(continued on page 56)

*Binoculars within each size group are listed in order of increasing price.



SOME MODELS FOCUS using an individual focus adjustment on each eyepiece (left) while others have a convenient center wheel (right).

as with telescopes, high power is not the advantage you might think it is. As you increase the power, you decrease the very trait you are seeking in a pair of binoculars, wide field of view. You sometimes sacrifice optical quality as well: High-powered binoculars are difficult to hold steady, so the greater detail you were hoping to gain by going to high power is lost because the image is shaking all over. The most popular magnifications for astronomical binoculars are 7x to 11x.

Exit pupil

Aperture and magnification combine to produce another key specification for an astronomical binocular, the exit pupil. Divide the aperture by the magnification and you get the binocular's exit pupil. This is the diameter of the beam of light the binocular projects into your eye. For example, a 7x50 binocular has an exit pupil of 7mm (50÷7). A 10x50 binocular produces an exit pupil of 5mm. A giant 16x80 binocular also gives a 5mm exit pupil.

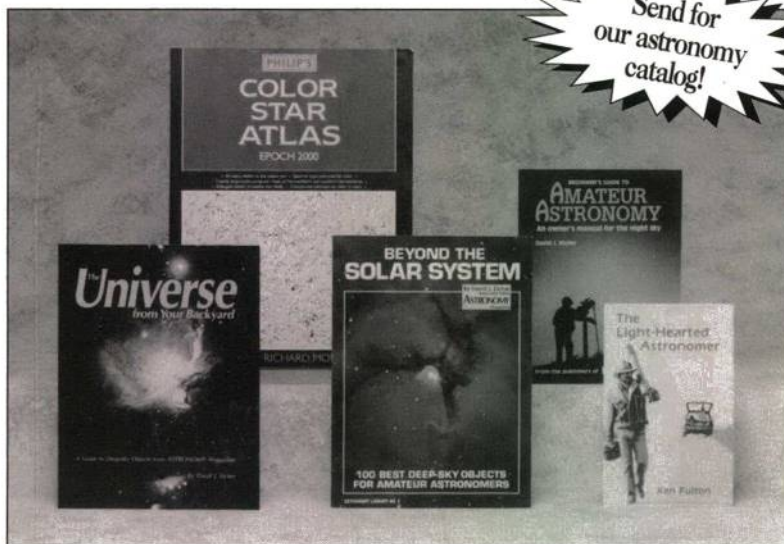
The best binoculars for astronomy are models with exit pupils from 5mm to 7mm. The diameter of the light cone projected from these binoculars nicely matches the diameter of the pupil of the human eye, assuming the eyes are dark adapted to nighttime conditions. These binoculars are providing as much light as your eyes can accept and, as a result, are producing the brightest images for their aperture.

Most human pupils can open no wider than 7mm, so a binocular with an exit pupil wider than 7mm would waste light — only the center of the light cone could enter the eyes. In fact, there are no binoculars with exit pupils greater than 7mm. Those with exit pupils equal to 7mm (7x50, 8x56, 9x63, and 11x80 models for example) are often called night glasses. These are some of the best models for astronomy.

As we get older, however, our pupils lose their ability to open wide at night.

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Manufacturer	Model	Actual FOV (°)	Apparent FOV (°)	Eye Relief (mm)	Coatings	Prism Type	Focus Type	Roll Down Cups	Tripod Socket	Armored	Water-proof	Case	Warranty (years)	Weight (oz.)	Retail*
7x50 MODELS (cont.)															
Tasco	Waterproof	6.8	48	13	C	BaK4	IF	✓	✓	—	✓	SV	Life	34	\$290
Edmund	Waterproof Marine	7.5	53	n/a	C	BK7	CF	✓	✓	✓	✓	HV	1	37	\$300
Swift	Sea Wolf BCF	6.8	48	16	C	BaK4	CF	✓	✓	✓	✓	—	Life	31	\$316
Fujinon	MT-SX Poseidon	7.5	53	12	FMC	BaK4	IF	✓	✓	option	✓	HV	Life	45	\$370
Swift	Sea Hawk BIF	7.3	51	13	C	BaK4	IF	✓	✓	✓	✓	—	Life	40	\$395
Bushnell	Marine	7.3	51	12	C	BaK4	IF	✓	✓	✓	✓	SV	Life	39	\$420
Minolta	Weathermatic	7.1	50	16	MC	BaK4	CF	✓	✓	✓	✓	HV	25	33	\$440
Nikon	Seafarer II	7.3	51	15	FMC	BaK4	IF	✓	—	✓	✓	—	25	61	\$450
Fujinon	FMT-SX Polaris	7.5	53	23	FMC	BaK4	IF	✓	✓	option	✓	HV	Life	52	\$490
Optolyth	Alpin	5.8	41	22	FMC	BaK4	CF	✓	—	✓	—	SL	30	23	\$490
Steiner	Military	7.0	49	21	MC	BK7	IF	✓	option	✓	✓	option	10	37	\$500
Swift	Sea King	7.0	49	18	C	BaK4	CF	✓	✓	✓	—	SV	Life	n/a	\$515
Mirador	BCF Exc-Series	7.3	51	13	MC	BaK4	CF	✓	✓	—	—	incl.	Life	46	\$549
Swarovski	SL Series	6.7	47	11	FMC	BaK4	CF	—	—	✓	✓	—	Life	41	\$570
Steiner	Admiral Gold	7.0	49	21	FMC	BaK4	IF	✓	option	✓	✓	option	30	37	\$700
Steiner	Hunting	7.3	51	21	FMC	BaK4	IF	✓	option	✓	✓	—	30	37	\$700
Unitron	Marine	7.3	51	11	C	BaK4	IF	✓	✓	✓	✓	HV	25	51	\$725
From Jena	Nobilem	7.5	53	17	FMC	BaK4	CF	✓	✓	option	partial	HL	Life	37	\$740
Nikon	IF-SP Prostar	7.3	51	15	FMC	BaK4	IF	✓	—	—	✓	HV	25	52	\$750
From Jena	8x50B Nobilem	7.2	58	10	FMC	BaK4	CF	✓	✓	option	partial	HL	Life	37	\$755
From Jena	Binocular	7.3	51	n/a	FMC	BaK4	CF	✓	✓	option	—	HL	Life	35	\$883
Pentax	PIF	7.3	51	20	FMC	BaK4	IF	✓	✓	✓	✓	SL	Life	56	\$960
Tasco	Waterproof	7.3	51	n/a	C	BaK4	IF	✓	✓	✓	✓	—	Life	52	\$993
Optolyth	Royal	7.7	54	10	FMC	Roof	CF	✓	—	✓	—	HL	30	36	\$1,300
Zeiss	B Marine	7.6	53	13	FMC	BaK4	IF	✓	—	✓	✓	—	30	44	\$1,760
10x50 MODELS															
Simmons	WA Red Line	7.0	70	5	C	BK7	CF	✓	—	—	—	SV	Life	26	\$72
Bushnell	Ensign	5.3	53	12	C	BK7	CF	✓	—	—	—	incl.	Life	32	\$90
Simmons	Euro-Gold WA	7.0	70	5	C	BK7	CF	✓	—	✓	—	SV	Life	28	\$90
Swift	Aerolite ZCF	7.0	70	10	C	BK7	CF	✓	—	—	—	SV	5	27	\$103
Tasco	Wide Angle	7.0	70	n/a	C	BK7	CF	✓	—	—	—	—	Life	26	\$107
Simmons	WA Armored	6.9	69	5	C	BK7	CF	✓	—	✓	—	HV	Life	31	\$113
Orion	Explorer	5.3	53	14	MC	BaK4	CF	✓	—	partial	—	HV	5	26	\$127
Bushnell	Camo Armored	7.0	70	12	C	BK7	CF	✓	—	✓	—	incl.	Life	29	\$130
Nikon	Lookout III	6.0	60	9	MC	BaK4	CF	✓	—	—	—	incl.	25	33	\$130
Simmons	Euro-Platinum	7.0	70	5	MC	BK7	CF	✓	—	✓	—	SV	Life	30	\$130
Nikon	Stayfocus Plus II	6.0	60	9	MC	BaK4	CF	✓	—	partial	—	incl.	25	34	\$140
Parks	GR	6.0	60	n/a	MC	BK7	CF	✓	✓	✓	—	HV	Life	n/a	\$140
Bausch&Lomb	Legacy EWA	7.9	79	10	MC	BaK4	CF	✓	✓	partial	—	incl.	Life	35	\$150
Celestron	WA Pro	6.5	65	15	FMC	BaK4	CF	✓	✓	✓	—	HV	Life	30	\$159
Orion	WA Ultraview	6.5	65	22	FMC	BaK4	CF	✓	✓	✓	—	HV	10	32	\$159
Bushnell	Spectator	7.0	70	12	C	BK7	CF	✓	—	✓	—	incl.	Life	26	\$160
Unitron	High Eyepoint	5.3	53	14	C	BK7	CF	✓	—	partial	—	HV	25	26	\$170
Mirador	BCF Series	7.0	n/a	n/a	C	BaK4	CF	✓	✓	—	—	HV	Life	25	\$171
Unitron	Armored	7.0	70	n/a	C	BK7	CF	✓	✓	partial	—	HV	25	30	\$190
Swift	Cougar ZWCF	7.0	70	13	C	BK7	CF	✓	✓	partial	—	SV	Life	29	\$210
Orion	Vista	5.3	53	16	FMC	BaK4	CF	✓	✓	—	—	HV	20	28	\$219
Bushnell	GlassesOn	6.5	65	17	C	BK7	CF	—	—	✓	—	SV	Life	35	\$220
Pentax	PCF II	6.5	65	14	FMC	BaK4	CF	✓	✓	✓	—	SL	Life	32	\$250
Tasco	Futura LE	5.3	53	18	C	BK7	CF	✓	—	✓	—	SV	Life	26	\$255
Minolta	XL Standard	6.5	65	20	MC	BaK4	CF	✓	✓	✓	—	HV	25	35	\$264
Carton	MC Adlerblick	5.0	50	18	FMC	BaK4	CF	✓	✓	partial	—	HV	20	24	\$270
Celestron	Ultima	5.0	50	21	FMC	BaK4	CF	✓	✓	partial	—	HV	Life	27	\$279
Redfield	Waterproof	5.0	50	12	FMC	Roof	CF	✓	—	✓	✓	SV	Life	29	\$325
Brunton	Eterna	6.5	65	21	FMC	BaK4	CF	✓	✓	✓	✓	SV	Life	33	\$369
Mirador	ZCFY-Series	5.0	50	16	MC	BaK4	CF	✓	✓	—	—	HV	Life	26	\$405
Swift	Audubon BWCF	7.0	70	10	MC	BaK4	CF	✓	✓	—	—	SV	Life	32	\$475
Optolyth	Alpin	5.1	51	16	FMC	BaK4	CF	✓	—	✓	—	SL	30	24	\$500
Steiner	Military/Marine	6.3	63	17	FMC	BK7	IF	—	option	✓	✓	option	10	36	\$500
Mirador	BWCF Exc-Series	7.0	70	13	MC	BaK4	CF	✓	✓	—	—	incl.	Life	46	\$585
From Jena	WA Dekaris	7.3	73	n/a	FMC	BaK4	CF	✓	✓	option	—	HL	Life	36	\$610
Steiner	Senator	6.2	62	17	FMC	BaK4	IF	—	option	✓	✓	—	30	36	\$700
Swarovski	SL Series	5.8	58	5	FMC	BaK4	CF	—	—	✓	✓	—	Life	36	\$950
Pentax	PIF	6.5	65	15	FMC	BaK4	IF	✓	✓	✓	✓	SL	Life	56	\$1,000
56mm and 60mm MODELS															
Orion	8x56 Mini-Giant	6.0	48	18	MC	BaK4	CF	✓	✓	option	—	HV	5	33	\$159
Celestron	8x56 Pro	5.8	46	22	FMC	BaK4	CF	✓	✓	✓	—	HV	Life	34	\$199
Celestron	8x56 Ultima	6.1	49	21	FMC	BaK4	CF	✓	✓	partial	—	HV	Life	31	\$299

(continued on page 58)

*Binoculars within each size group are listed in order of increasing price.

For those of us over 40, our pupils commonly open no wider than 5mm to 6mm, even when our eyes are fully dark adapted. Under these conditions, binoculars with a 5mm to 6mm exit pupil are best. This includes 7x42, 8x42, 10x50, 15x80, and 16x80 models.

Actual field of view

Two binoculars with the same magnification and aperture, two 10x50s for example, can provide quite different fields of view. A wide-angle 10x50 will show more of the sky than a standard-field 10x50 will. The difference lies in the type of eyepiece used.

Field of view is often given in "feet at 1,000 yards" or "meters at 1,000 meters." These numbers tell you how wide an object would completely fill the field if it were 1,000 yards or meters away. But in astronomy we are looking at objects across the universe. For us, a field of view measured in degrees makes more sense. A field of 5°, for example, encompasses 10 Full Moon diameters or the distance between the Pointer Stars of the bowl of the Big Dipper.

To convert "feet @ 1,000 yards" into degrees, divide by 52.5. To convert from "meters @ 1,000 meters," divide by 17.

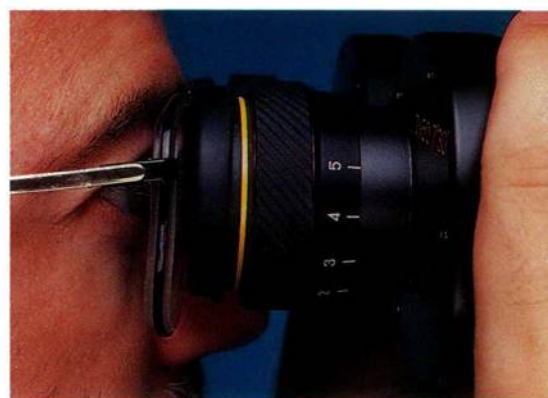
A binocular said to give a field of 367 feet at 1,000 yards, a common number, will produce an angular field of 7°. A binocular with a field of 120 meters at 1,000 meters will also yield a 7° field.

A field of 5° to 7° is normal for most 7x binoculars. Wide-angle models may show 8° to 10° of sky.

Apparent field of view

Another way to compare binoculars is by their apparent field. To calculate apparent field, multiply the actual field in degrees times the magnification. For example, a 7x binocular that shows 7° of sky has an apparent field of 49°. This number tells you how wide a circle of light you will see when you look through the binoculars. Apparent fields of 50° are normal for most models. Wide-angle binoculars can have apparent fields of up to 70°. Binoculars with narrow apparent fields of 40° will give you the effect of looking through a tunnel.

Getting as wide a field as possible might seem best, but there are tradeoffs. Wide-angle binoculars usually exhibit distorted or out-of-focus star images at the edges of the field. And with wide-angle binoculars you usually have to sacrifice what is known as eye relief.



LONG EYE RELIEF is critical if you want to keep your glasses on when using binoculars. Keeping eyeglasses on produces sharper images and is more convenient.

Eye relief

Eye relief is the distance your eye needs to be from the top of the eyepiece in order to see the entire field at once. As a general rule, wide-angle binoculars have reduced eye relief; your eyes need to be quite close to the eyepiece to see anything.

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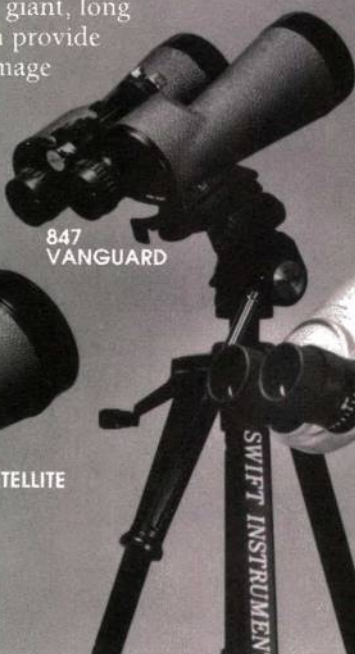
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Manufacturer	Model	Actual FOV (°)	Apparent FOV (°)	Eye Relief (mm)	Coatings	Prism Type	Focus Type	Roll Down Cups	Tripod Socket	Armored	Water-proof	Case	Warranty (years)	Weight (oz.)	Retail*
56mm and 60mm MODELS (cont.)															
Pentax	8x56 DCF	6.5	52	21	FMC	Roof	CF	✓	✓	✓	✓	SL	Life	41	\$710
Steiner	8x56 Hunting	6.6	53	20	FMC	BaK4	IF	✓	option	✓	✓	—	30	41	\$800
From Jena	8x56W	6.7	54	16	FMC	BaK4	CF	✓	✓	—	partial	HL	Life	44	\$895
Swarovski	8x56 SL Series	5.8	46	11	FMC	BaK4	CF	✓	—	✓	✓	—	Life	43	\$994
Optolyth	8x56 Royal	6.7	54	10	FMC	Roof	CF	✓	—	✓	—	HL	30	39	\$1,230
Zeiss	8x56 B/GA T* Dialyt	6.3	50	16	FMC	Roof	CF	✓	—	✓	✓	incl.	30	36	\$1,565
Zeiss	8x56B Design Select.	7.5	60	n/a	FMC	Roof	CF	✓	—	✓	✓	SL	30	52	\$1,565
From Jena	10x60W	5.8	58	n/a	FMC	BaK4	CF	✓	✓	—	partial	HL	Life	39	\$1,075
Zeiss	10x56B Design Select.	6.3	63	n/a	FMC	Roof	CF	✓	—	✓	✓	SL	30	50	\$1,700
9x63 MODELS															
Celestron	Pro	5.0	45	21	FMC	BaK4	CF	✓	✓	✓	—	HV	Life	37	\$229
Pentax	DCF	5.8	52	21	FMC	Roof	CF	✓	✓	✓	✓	SL	Life	44	\$780
Optolyth	Royal	6.1	55	10	FMC	Roof	CF	✓	—	✓	—	HL	30	42	\$1,435
70mm MODELS															
Orion	10x70 MC Giant	5.0	50	15	FMC	BaK4	CF	✓	✓	—	—	HV	5	58	\$277
Fujinon	10x70 MT-SX Poseidon	5.3	53	12	FMC	BaK4	IF	✓	✓	—	✓	HV	Life	73	\$460
Fujinon	10x70 FMT-SX Polaris	5.3	53	23	FMC	BaK4	IF	✓	✓	—	✓	HV	Life	76	\$590
Unitron	10x70 Giant	5.0	50	n/a	C	BaK4	IF	✓	✓	—	✓	incl.	25	50	\$1,040
Nikon	10x70 IF-SP Astroluxe	5.1	51	15	FMC	BaK4	IF	✓	—	—	✓	HV	25	88	\$1,200
Orion	14x70 MC Enhanced	4.0	56	17	FMC	BaK4	CF	✓	✓	—	—	HV	5	58	\$288
Fujinon	16x70 FMT-SX Polaris	4.0	64	12	FMC	BaK4	IF	✓	✓	—	✓	HV	Life	76	\$650
11x80 MODELS															
Orion	11x80 Standard	4.2	n/a	n/a	MC	BaK4	CF	✓	✓	—	—	HV	n/a	n/a	\$349
Orion	MC Giant	4.5	50	16	FMC	BaK4	CF	✓	✓	—	—	HV	5	77	\$370
Celestron	Giant	4.5	50	18	FMC	BaK4	CF	✓	✓	—	—	HV	Life	80	\$379
Parks	Deluxe Giant	4.5	50	n/a	MC	BPG2	CF	✓	✓	✓	—	HV	Life	80	\$479
Unitron	Giant Observation	4.5	50	n/a	C	BaK4	CF	✓	✓	—	—	incl.	25	56	\$550
Mirador	BCF Observation	4.5	n/a	n/a	MC	BaK4	CF	✓	✓	—	—	HV	Life	61	\$612
Swift	Observer BCF	4.5	50	16	C	BaK4	CF	✓	✓	—	—	HV	Life	78	\$650
Bausch&Lomb	Discoverer	4.4	48	12	MC	BaK4	CF	✓	✓	—	—	incl.	Life	80	\$730
From Jena	11x80W	4.6	51	n/a	FMC	BaK4	CF	✓	✓	—	partial	HL	Life	58	\$1,425
15 and 16x80 MODELS															
Celestron	15x80 Giant	3.5	53	16	FMC	BaK4	CF	✓	✓	—	—	HV	Life	80	\$399
Parks	15x80 Deluxe Giant	3.5	53	n/a	MC	BPG2	CF	✓	✓	✓	—	HV	Life	80	\$499
Steiner	15x80 Observer	3.7	55	11	FMC	BaK4	IF	✓	✓	✓	✓	option	30	56	\$1,100
From Jena	15x80W	4.3	64	n/a	FMC	BaK4	CF	✓	✓	—	partial	HL	Life	58	\$1,475
Fujinon	15x80 MT	4.0	60	15	FMC	BaK4	IF	—	✓	—	✓	—	Life	248	\$2,650
Orion	16x80 Standard	n/a	n/a	n/a	MC	BaK4	CF	✓	✓	—	—	HV	n/a	n/a	\$349
Orion	16x80 MC Giant	3.5	56	16	FMC	BaK4	CF	✓	✓	—	—	HV	5	77	\$390
20x80 MODELS															
Orion	MC Giant	3.5	70	15	FMC	BaK4	CF	✓	✓	—	—	HV	5	77	\$399
Celestron	Giant	3.5	70	14	FMC	BaK4	CF	✓	✓	—	—	HV	Life	80	\$419
Parks	Deluxe Giant	3.5	70	n/a	MC	BPG2	CF	✓	✓	✓	—	HV	Life	80	\$539
Unitron	Giant	3.5	70	n/a	C	BaK4	CF	✓	✓	—	—	incl.	25	56	\$605
Swift	Satellite	3.5	70	14	C	BaK4	CF	✓	✓	—	—	HV	Life	80	\$690
Bausch&Lomb	Discoverer	2.7	54	12	MC	BaK4	CF	✓	✓	—	—	incl.	Life	80	\$760
Miyauchi	20x77 Model	2.5	50	27	FMC	BaK4	IF	✓	✓	—	partial	option	Life	158	\$895
From Jena	22x80W	3.2	70	n/a	FMC	BaK4	CF	✓	✓	—	partial	HL	Life	60	\$1,475
100mm and larger MODELS															
Orion	14x100 BIF Supergiant	3.3	46	24	FMC	BaK4	IF	✓	✓	—	—	Metal	5	112	\$777
Swift	20x100 Titan	2.5	50	27	C	BaK4	IF	✓	✓	—	✓	—	Life	208	\$2,000
Miyauchi	20x100 BJ-100IA	2.5	50	27	FMC	BaK4	IF	✓	✓	—	partial	option	Life	171	\$2,395
Tasco	20x100 Apochromatic	2.5	50	27	FMC	BaK4	IF	✓	✓	—	✓	—	Life	208	\$6,790
Orion	25x100 Supergiant	2.6	65	10	FMC	BaK4	CF	✓	✓	—	—	Metal	5	120	\$899
Parks	25x100 BWCF	2.5	63	n/a	MC	BaK4	CF	✓	✓	—	—	incl.	Life	208	\$999
Edmund	25x100 Giant	2.6	65	n/a	C	BK7	CF	✓	✓	—	—	Metal	1	140	\$1,775
Fujinon	25x150 MT	2.7	67	18	FMC	BaK4	IF	—	✓	—	✓	—	Life	1,000	\$9,500
Fujinon	25x150 ED-MT	2.7	67	18	FMC	BaK4	IF	—	✓	—	✓	—	Life	1,000	\$11,900

*Binoculars within each size group are listed in order of increasing price.

KEY:

Actual FOV	Actual field of view (in degrees).
Apparent FOV	Apparent field of view (in degrees).
Eye Relief	Distance eyes need to be back from the binocular to see the entire field (in millimeters).
Coatings	Type of optical coatings. C = single-layer; MC = some surfaces multicoated; FMC = all surfaces multicoated.
Prism Type	Either BK7 or BaK4 porro prisms, or roof prisms.
Focus Type	Either CF (center focus) or IF (individual focus).
Roll Down Cups	Rubber eye cups fold down to facilitate viewing with eyeglasses.
Tripod Socket	Model has 1/4-20 threaded socket for attaching tripod adapter bracket.

Armored

Model is fully rubber armored. "Partial" indicates unit has soft covering over part of body; "option" indicates model is available in armored version.

Waterproof

Model is waterproof. "Partial" indicates model is water-resistant or splashproof.

Case

Model comes with a case. SV = soft vinyl; HV = hard vinyl; SL = soft leather; HL = hard leather.

Warranty

Model's warranty period (in years).

Weight

Body weight (in ounces).

Retail

Typical retail price, or suggested retail price as supplied by manufacturer. Actual prices at dealers may vary.

TRIPOD SOCKETS make it easy to attach the binoculars to a camera tripod, a preferred method of using binoculars to explore the night sky.

An eye relief of 10mm to 15mm is normal for most eyepieces. Less than that and you have to press your eyes uncomfortably close to the eyepiece lenses.

If you wear glasses and wish to keep them on while viewing through your binoculars, you'll need binoculars with at least 15mm of eye relief. Models with eye relief of 20mm or more are ideal for eyeglass wearers. This requirement may rule out wide-angle binoculars (those with apparent fields of 60° to 70°) for eyeglass wearers, as few of these models have eye relief greater than 15mm.

Coatings

Optical coatings placed on the surfaces of lenses and prisms increase light transmission (giving brighter images) and cut down on internal flare and reflections (increasing contrast). Most binoculars feature at least single-layer coatings on some air-to-glass surfaces. Better binoculars have all optical surfaces with one layer of coating and some surfaces treated with multiple coatings for even greater light transmission and contrast. In the best binoculars all optical surfaces are multi-coated. Quite often the difference in clarity between otherwise similar models of binoculars stems from the coatings.

When inspecting a pair of binoculars, look down onto the main lenses. Do you see lots of white reflections from lights or windows? If so, it is a sign the optics are not multicoated or not coated at all. In a fully multicoated binocular the reflections will be dim and will look deep green, blue, or purple.

Type of prisms

Binoculars are compact because they use prisms to fold the light path back and forth within the body of the binocular. Porro-prism binoculars are the most common and most affordable. These models have the familiar N-shaped bodies. Roof prism binoculars have straight tubes, making them more compact. But roof prism binoculars are more costly to make well, putting the best of these models in the premium price class.

For astronomy, all but the finest roof prism binoculars are outperformed by porro-prism models. Roof prisms split the image into two and then recombine it, a process that can lead to spikes of light off bright stars on lower cost models. Porro prism binoculars of any price tag don't have this quirk.

However, not all porro prism binoculars are equal. Ones with prisms made of BK7 glass are economical but suffer from some dimming of the edge of the field.



Better binoculars use BaK4 glass prisms for the brightest field of view.

Mechanical Features

Type of focusing mechanism

Most binocular focus with a central thumbwheel that moves both eyepieces back and forth in tandem. These "center-focus" models also have a separate adjustment on one of the eyepieces (usually the right eyepiece) to compensate for any difference in focus between your two eyes. Because focusing requires only one quick adjustment, center-focus binoculars are the easiest to use.

Some models use a focus adjustment on each eyepiece. Focusing these "individual-focus" models means always having to adjust two eyepieces. This is inconvenient and slow. The reason for going this route is that it is difficult to make center-focus binoculars waterproof. Individual focus is the method of choice for marine binoculars. For applications such as astronomy, where the subject is always at the same distance, constant refocusing is not necessary and the inconvenience of individual focus eyepieces is not a problem and may be a fair tradeoff for other features.

Waterproofing

Some binoculars are built to survive being plunged into water. Others, known as splashproof or fogproof, are only water resistant and won't survive



LOWER-COST BK7 PRISMS

(bottom) present a square patch of light when held away from the eyes. Better BaK4 prisms (above) show an evenly lit disk of light.

immersion. While neither class of waterproofing might seem useful for astronomy, in practice waterproof binoculars are a good choice. After a constant routine of exposure to damp night air and condensation from warm rooms, binoculars can develop hazy images if mold or mildew form inside the optics. Cleaning the optics can be expensive.

Armoring

Waterproof binoculars intended for rough use usually feature some type of rubberized covering over the body to absorb shock and vibration. Such armoring is of some value for astronomy, but with care any binocular can last a lifetime. While waterproof binoculars are often armored, armored binoculars aren't necessarily waterproof.



Roll-down eyecups

Many models, especially those with long eye relief, have rubber eyecups on the eyepieces. If you don't wear glasses, keep the eyecups rolled out; the cups help block stray light and keep your eyes comfortably at the right distance from the eyepieces. If you wear glasses, you roll down the eyecups to see the entire field. The rubber ring surrounding the eyepiece prevents glasses from being scratched.

Tripod socket

The best way to improve the view

through binoculars is to place them on a tripod. A steady image will reveal small details such as the moons of Jupiter and small star clusters. Many binoculars feature a 1/4-20 socket that accommodates a bracket for tripod attachment.

Weight

Even within a standard size such as 7x50, binoculars can vary considerably in weight, depending on the size of the prisms employed, body composition, and features such as armoring and waterproofing. If they are to be held, a weight under 30 ounces is best. Larger

RUBBER ARMORING helps guard the binocular against minor bumps and abrasions but won't protect it from damage if its accidentally dropped on the ground.

40- to 50-ounce models are difficult to hold steady for any length of time, and for giant 60- to 100-ounce binoculars, placing them on a tripod is essential.

Cost

Pick any size of binocular and there's a wide range in prices in that class. As you go up the price ladder, you get better prisms, better coatings, longer eye relief, and slightly sharper images, especially in images at the edge of the field. You also get more rugged construction and completely sealed, waterproof optics. But you needn't spend a great deal to get a good deal. You can find binoculars in the \$100 to \$150 range that will provide many features and enough value to last you many years of use.

Recommended Binoculars

For astronomy, everyone should own a pair from the 40- to 50mm-aperture class. These are the lightweight, all-purpose binoculars you'll use most often, even after you acquire a telescope. Those wanting a true 7mm exit pupil or the longest eye relief should select a 7x50 or 8x56. Older viewers or those

Who Makes Binoculars

Write or call the following companies for more information about their binoculars and for the location of dealers near you.

BINOCULAR MANUFACTURERS

Adlerblick, c/o Carton Optics, 1037 Enderby Way, Sunnyvale, CA 94087, (408) 245-4818.

Adorama, 42 West 18th St., New York, NY 10011, (212) 741-0401.

Bausch & Lomb Sport Optics Division (also Jason), 9200 Cody, P.O. Box 14930, Overland Park, KS 66214, (913) 888-0220.

Brunton Company, 620 East Monroe, Riverton, WY 82501, (307) 856-6559.

Celestron International (also Vixen), 2835 Columbia St., Torrance, CA 90503, (310) 328-9560.

Edmund Scientific, 100 East Gloucester Pike, Barrington, NJ 08007, (609) 547-3488.

From Jena, c/o Europtik, Ltd., P.O. Box 319, Dunmore, PA 18512, (717) 347-6049.

Fujinon Inc., 10 High Point Dr., Wayne, NJ 07470, (201) 633-5600.

Leica Camera Group, 156 Ludlow Avenue, Northvale, NJ 07647, (201) 767-7500.

Meade Instruments Corporation, 16542 Millikan Avenue, Irvine, CA 92714, (714) 756-2291.

Minolta Corporation, 101 Williams Drive, Ramsey, NJ 07446, (201) 934-5437.

Mirador Optical Corp., P.O. Box 11614, Marina del Rey, CA 90295, (310) 821-5587.

Miyauchi, c/o Land, Sea, and Sky/Texas Nautical Repair, 3110 S. Shephard, Houston, TX 77098, (713) 529-3551.

Nikon Inc., 1300 Walt Whitman Road, Melville, NY 11747-3064, (516) 547-4200.

Optolyth USA, 3021 N.E. 47th St., Fort Lauderdale, FL 33308, (305) 351-0364.

Orion Telescope Center, 2450 17th Avenue,

P.O. Box 1158, Santa Cruz, CA 95061, (800) 447-1001.

Parks Optical, 270 Easy St., Simi Valley, CA 93065, (805) 522-6722.

Pentax Corporation, 35 Inverness Drive East, Englewood, CO 80112, (303) 799-8000.

Redfield Inc., 5800 E. Jewell Avenue, Denver, CO 80224, (303) 757-6411.

R.V.R. Optical, P.O. Box 62, Eastchester, NY 10709, (914) 337-4085.

Selsi Company, Inc., 40 Veterans Blvd., Carlstadt, NJ 07072, (201) 935-0388.

Simmons Outdoor Corporation, 14530 SW 119 Ave., Miami, FL 33186, (305) 252-0477.

Steiner Binoculars, c/o Pioneer Marketing, 216 Haddon Ave., Suite 500, Westmont, NJ 08108, (609) 854-2424.

Swarovski Optik, 2 Slater Road, Cranston, RI 02920, (401) 942-3380.

Swift Instruments, Inc., 952 Dorchester Ave., Boston, MA 02125, (617) 436-2960.

Tasco, 7600 MW 26th St., Miami, FL 33122, (305) 591-3670.

Unitron, 170 Wilbur Place, P.O. Box 469, Bohemia, NY 11716, (516) 589-6666.

Vivitar Corporation, 9350 DeSoto Avenue, Chatsworth, CA 91311, (213) 870-0181.

Zeiss (Carl Zeiss Optical, Inc.), P.O. Box 70549, Richmond, VA 23255, (804) 346-4309.

wanting slightly higher power for greater resolution of small deep-sky objects, should select a 10x50. Those wanting a slightly smaller, lighter binocular for serving double duty as a birding or daytime instrument should select a 7x42 or 8x42 model.

After you own a small binocular that can be held comfortably in your hands, you might consider buying a giant 70mm- or 80mm-class instrument. Essentially twin telescopes, these can provide stunning views of comets, deep-sky objects, and starfields. For a 7mm exit pupil and for the widest field, select a 10x or 11x model. For the higher power required to resolve many star clusters and to pick out small galaxies, select a 15x or 16x model. Big 20x80 binoculars are praised by some amateurs, but their narrow 3.5° fields of view make them more difficult to use for beginners. You also sacrifice eye relief when you move to higher power models.

Adding Accessories

Binoculars need very little in the way of accessories. The priority item is a tripod adapter. These inexpensive L-shaped brackets are available from many telescope dealers. Binoculars without a tripod socket can be fastened

to a tripod with flexible wrap-around holders.

Although a conventional camera tripod works fine for small binoculars, the best mounting solution for big 70 to 100mm binoculars is one of the binocular stands now offered by several manufacturers. These cantilevered devices hold the binoculars away from the tripod so you can get underneath them when

you want to aim high. An even more luxurious accessory is some type of binocular observing chair. These suspend the binoculars in front of your eyes, while you remain comfortably seated scanning the skies.

For the names and addresses of companies who make these accessories, see the entries under "Binocular stands and tripod adapters" on page 47.

Binoculars to Avoid

Astronomy places great demands on binocular optics. Pinpoints of light — stars — spread across the entire field will reveal optical flaws that normally wouldn't be seen. While binoculars of any size can be used for astronomy, there are two varieties you should not buy if exploring the night sky is your main goal.

Zoom binoculars, with their variable power magnification, sound like a good deal. But in practice, almost all suffer from inferior optical quality and fields of view much narrower than those provided by single-power models.

Fixed-focus binoculars are permanently set to be in focus for objects a few hundred feet away. When aimed at stars at infinity, these binoculars show fuzzy images. With no way to adjust the focus for your eyes and for the distance you need for astronomical use, all fixed-focus binoculars are best left on the showroom shelves.

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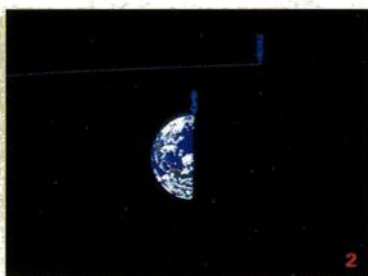
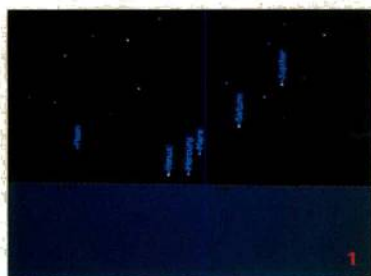
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1 Dawn from Xi'an, March 3, 1953 bc. The new moon and a grand planet alignment began the Chinese calendar.

2 The closest known Earth-asteroid passage, less than half the lunar distance. 1993ka2 is actually in the foreground exaggerating the closeness.

3 Lunar eclipse in Taurus on Nov. 29, 1993.

4 The star 28 Sgr in the "right elbow" of Saturn (north is down). From Colorado, July 3, 1989, 2 a.m.

5 Sky map showing planet epicycles and comet Halley's path from Jan. 1, 1985 to Apr. 20, 1986.

6 Lunar occultation of Jupiter, Oct. 7, 1994 from the southern hemisphere. Note Galilean moons.

7 A less familiar solar system. Orbits of newly discovered Kuiper belt planetesimals shown.

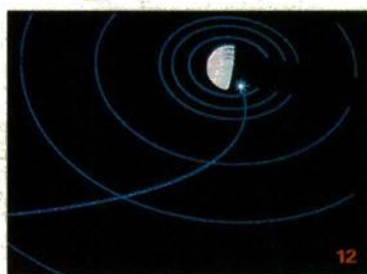
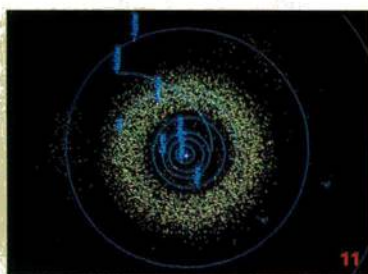
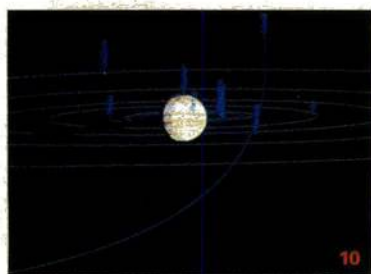
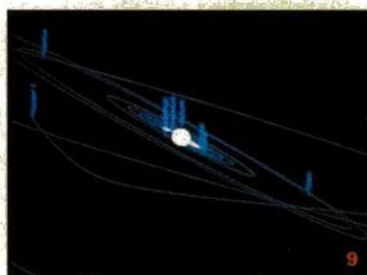
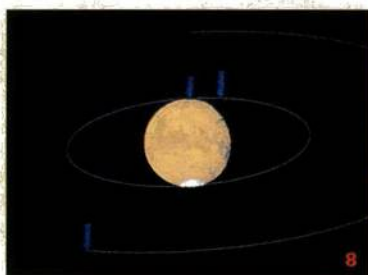
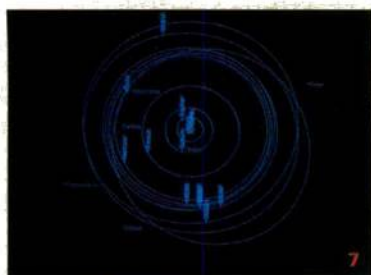
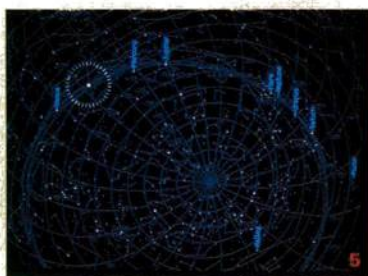
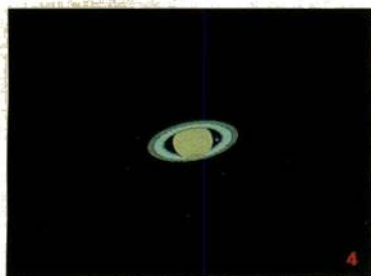
8 July 29: Mars at western stationary position before the excellent opposition of 2003. Note phase.

9 November, 1980. After passing directly below Titan, Voyager 1 is deflected up out of the ecliptic by Saturn's gravity.

10 July 25, 1779. This earliest known Jupiter-comet strong perturbation ejects Lexell's comet from the solar system.

11 The asteroids on July 16, 1994. Note the positions of the Galileo spacecraft and the earlier imaged asteroids Gaspra and Ida.

12 20 fragments of Shoemaker-Levy 9 on July 16, 1994. View is below Jupiter and nearly along the comet path, making the fragments appear closer together than they actually are.



Unretouched screen shots from Dance of the Planets.

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& COMPUTERS ASTRONOMY



Planetarium-type program: Voyager II by Carina Software

If you haven't checked out the universe of astronomy available on computers, you don't know what you're missing.

Ten years ago few astronomical programs existed. By contrast, a dizzying collection of excellent ones exists today. If you're a potential buyer, you probably feel a little overwhelmed. This guide attempts to alleviate that by describing some of the programs available and explaining how to choose them. And because a computer is capable of doing much more than running a program, this guide also lists electronic bulletin boards that can be accessed (see "Electronic Connections") and CD-ROMs that can be purchased and used for data and image storage (see "Megastorage").

The heart of the computer universe lies in software that lets observers explore the richness of the night sky, plan and record observations, and enhance images. Though many of the programs speak to the needs of observers, armchair astronomers

GLOSSARY OF COMPUTER TERMS

COMPUTER HARDWARE

8086, 80286, 80386, 80486: Manufacturers' numbers for the computer chip that forms the brain of your computer.

math coprocessor: An extra circuit chip that quickly performs complex math functions that the computer chip does at a much slower rate.

CD-ROM: Compact disk, read only memory — a disk like an audio CD that can hold hundreds of megabytes of data from which you can read but not write.

RAM: Random access memory — the place where your computer stores programs and data.

byte: A basic unit of computer memory and disk space that stores one character or numeral.

kilobyte (KB): 1,024 bytes, or characters, of computer memory or disk storage.

megabyte (MB): 1,024 kilobytes, or roughly a million characters.

gigabyte (GB): 1,024 megabytes, or roughly a billion characters.

IMAGE FILE FORMATS

BMP: Bitmap image, commonly used in Windows programs.

FITS: Flexible image transport system, commonly used for CCD images.

GIF: Graphics interchange format, developed by CompuServe and commonly used by bulletin boards.

JPEG: Joint Photographic Experts Group, commonly used to compress image files so they use less room on disks.

Photo CD: Kodak's CD, used to store digitally scanned photographs.

PICT: Picture format, used by Macintosh programs.

PIX: Picture format, used by some PC screen capture programs.

RAW: An image file without any special formatting information, sometimes used by CCD cameras.

TIFF: Tag image file format, used by many graphics and image-processing programs for its flexibility.

NETWORK TERMS

baud: Number of bits (8 bits = 1 byte) a modem sends every second.

bulletin board: A computer system you can link with using a modem; it contains programs, messages, and text files.

e-mail: A system that sends messages electronically via a computer network.

freeware: A program the developer shares at no cost.

modem: A device that links your computer to another via a phone line.

shareware: A program you can try for a limited period — if you like it, you pay the developer a fee, which may entitle you to upgrades or a more powerful program.

VIDEO DISPLAYS

adaptor: A card or chip inside your computer that produces the screen display.

CGA: Color graphics adaptor, displays up to 640 by 200 elements and up to 4 colors.

EGA: Enhanced graphics adaptor, displays up to 640 by 350 elements and up to 16 colors.

VGA: Video graphics array, displays up to 640 by 480 elements and up to 256 colors.

Super VGA: A better-than-VGA adaptor that displays up to 1,024 by 768 elements and thousands of colors.

high resolution: an adaptor that displays up to 1,280 by 1,024 elements.

Observers can do many of the tasks that computers perform — making finder charts, plotting the position of a new comet, and entering notes about star clusters from an observing session. But who wants to spend hours redrawing charts by hand or computing the position of an asteroid using a calculator or a pencil and a piece of paper? Computers can save time — and drudgery — and let observers spend more time at the telescope. With a computer, you can control your telescope and observe from the comfort of your home.

Selecting software involves many personal choices, so this guide can't say which programs are best for you. But to help you decide, it does indicate which programs are DOS-, Windows-, or Mac-based and which require special hardware such as a math coprocessor, a CD-ROM drive, or a particular display. The glossary opposite deciphers the morass of acronyms that computer buffs use.

Planetarium-type programs show the positions of the stars and planets and display constellation figures. Most of these programs will show deep-sky objects such as star clusters and galaxies. Some will also plot the positions of asteroids, comets, and the past and future positions of planets.

Deep-sky observing programs excel at showing the positions of numerous galaxies, nebulae, and star clusters. These programs also show the positions of stars, sometimes plotting fainter stars than planetarium-type programs. They also print finder charts for use at a telescope.

Image-processing programs enhance images with a variety of techniques that mimic what photographers perform in their darkrooms. (See "Image Processing.")

Special-purpose programs explore binary stars, plot the path of an eclipse, explore telescope optics, investigate the orbits of stars and planets, view Mars from its surface, make a planet, keep logs of observing sessions, and much, much more. (See "Expanding Your Horizons.")



Sky simulator: PC- Sky by CapellaSoft



Deep-sky observing program: HyperSky II by Willmann-Bell

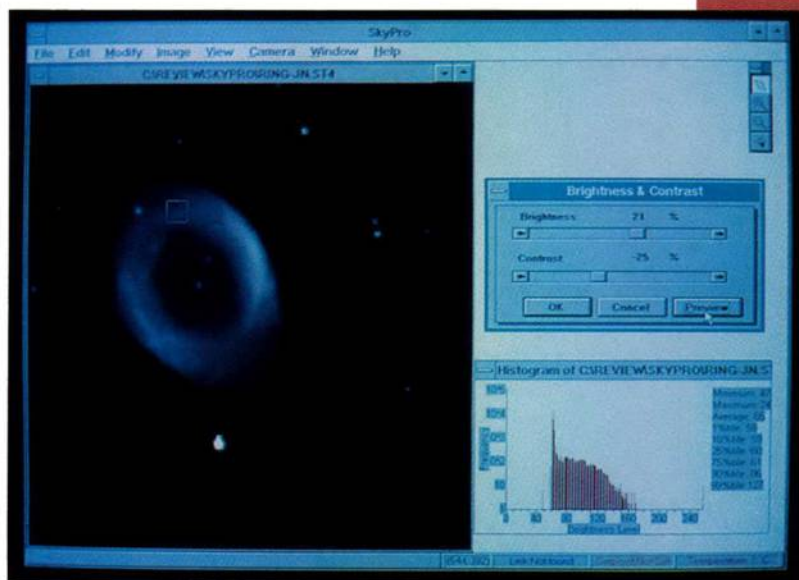
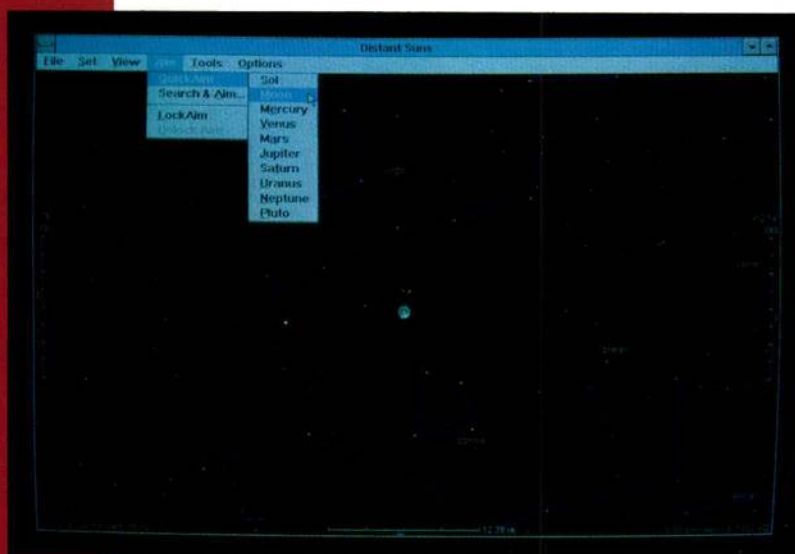


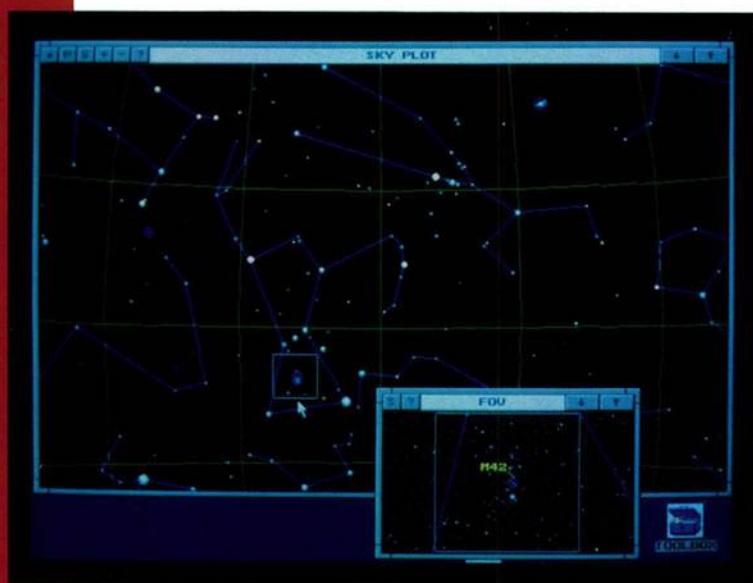
Image-processing software: SkyPro by Software Bisque



Dance of the Planets by ARC Science Simulations



Distant Stars for Windows by Virtual Reality



StarGaze by C.E.B. Metasystems

Planetarium-type programs, sky simulators, deep-sky software, and observatory programs all open a window to the universe for personal computer users. These observing programs indicate the planets' positions each night, determine the phase of the Moon, locate deep-sky objects such as nebulae and galaxies, plan an observing session, or create a finder chart for use at the telescope. These programs work for armchair explorers as well by showing the position of a planet 1,000 years ago or helping determine its coordinates 1,000 years in the future. The programs also display the distribution of star clusters throughout the Galaxy, animate the motions of planets through the sky, and show the planets from different positions within the solar system.

The one you choose depends on the observing you do or the phenomena you want to explore.

Choices were easier several years ago because few programs existed, especially for Windows-based or Macintosh computers. But now many fine programs are available for different types of computers and their various operating systems. Before purchasing a program, note if it requires a special video display, a math coprocessor, or an extraordinary amount of hard-disk space. Most Windows-based programs still work in 3.0 but a few require 3.1. A few Mac programs now require System 7.X. More and more programs offer CD-ROMs as an option for extending their database or for loading the program and database.

One factor in deciding between observing programs is the extent of their databases. Traditionally these programs have used the *Bright Star Catalog* to show the positions and brightnesses of over 9,100 stars brighter than about magnitude 6.5 — or a portion of this catalog. Others used the 250,000 stars of the Smithsonian Astrophysical Observatory (SAO) star catalog, extending the brightness limit to 8th magnitude. Now many of the programs use the Hubble *Guide Star Catalog* with its over 15 million stars or provide this catalog as an option. In either case a CD-ROM drive is needed to use this catalog.

The position and brightness of galaxies, nebulae, and star clusters form a program's deep-sky object database. Some of the inexpensive programs use only Charles Messier's catalog of 110 objects. Most use part or all of the *New General Catalogue* that lists almost 8,000 objects. A few deep-sky observing programs add other catalogs to this basic database, including fainter nebulae, galaxies, and star clusters. With these extra catalogs, users can customize their observing database to concentrate on their interest in double stars, supernovae remnants, open star clusters, globular star clusters, or other types of objects.

While deep-sky programs have extensive databases, not of all of them display the planets — but planetarium-type programs will. So a planetarium-type program can still be a helpful tool for deep-sky observers, especially for finding the phase and location of the Moon. Some of these programs show the four largest satellites of Jupiter

and a few also feature other planetary satellites. Many of the programs now add comets and asteroids to their database or permit the user to add elements that describe an object's orbit so the program calculates a comet's or asteroid's position for any time. This latter method is superior because the program can then determine the rapidly changing orbit of a comet such as Shoemaker-Levy 9, which collided with Jupiter in July 1994. Updated orbital elements for comets and asteroids are often available on astronomical bulletin boards or on-line computer services (see "Electronic Connections").

Some of the observing programs display images of the planets and some deep-sky objects or let users add personal digital images to the file. This feature appeals greatly to organizers of Astronomy Day programs, club events, school presentations, or anyone who needs a convenient means of keeping track of favorite astronomical photos.

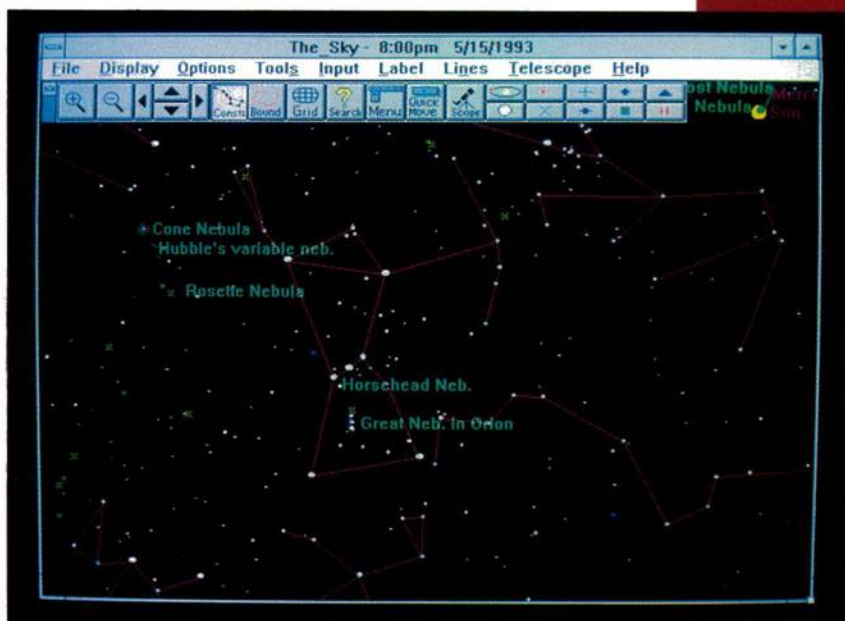
To keep track of the skies as they were over 100 years ago or how they will be 100 years from now, chose a program that calculates precession, the slow wobble of Earth's axis over 26,000 years. Exploring ancient skies is one way to get a better feel for how our ancestors viewed the universe: It didn't always look the way it does today. Be warned that not all programs use orbital calculation methods that are precise enough to compute planetary positions far into the past or future, so check the program's accuracy.

Most programs can animate the motions of current solar system events such as the next solar eclipse or the path of an upcoming opposition. While the eclipse feature will show only the disappearance of the Sun as the Moon passes in front of it, another program is available that plots the path across Earth's surface (see "Expanding Your Horizons"). The animation feature can also find conjunctions (groupings of the planets in the sky) and possible occultations (events that occur when the Moon passes in front of a star).

Two more useful features to look for include the program's ability to print finder charts and to show the finderscope's or eyepiece's field of view. If the program can print finder charts, be sure that chart-printing routine works with the printer. Check that different classes of deep-sky objects are selectable to make customizing the chart easier. Some programs permit users to attach labels to objects on the chart or to keep observing notes for each object.

The other useful item displays a reticle or circle on the screen showing the size a finderscope's or eyepiece's field of view. Some of these programs show the actual size of an object, not just a symbol in its position. And one program even shows the orientation of a galaxy in the sky.

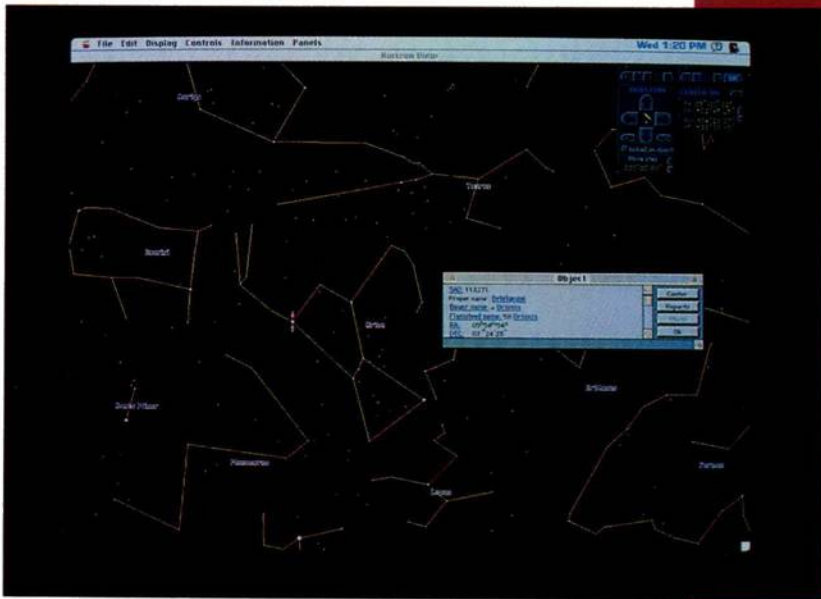
Finally, those who own a computerized scope can run it with a planetarium-type or observatory program. These programs are easy to use once loaded: simply select the desired object on the screen with the cursor, and a click of the mouse button will send the telescope on its way to the object. Many programs will control Meade's LX-200 series of telescopes and some will also control a CCD camera. For another scope, check with the software developer to see if their program will work with that model.



TheSky for Windows by Software Bisque



MegaStar by E.L.B. Software



RedShift by Maris Multimedia

PLANETARIUM-TYPE PROGRAMS

Program Name	Version	Developer	Price	Comp	System	CD-ROM	H. Drive	Mem	Display	# Stars	# Objects	Opt DB	Rev.
Big Blue Skies		Andromeda Soft.	\$	PC	DOS		—	—	VGA	1,500	—	3,200 stars	
Dance of the Planets	2.7	ARC Sci. Sim.	\$145	PC (286)	DOS		1.2 MB	640KB	VGA	9,100	1,400	yes	5/92
Dance of the Planets	Q.E.D.	ARC Sci. Sim.	\$195	PC (286)	DOS		yes	640KB	VGA	9,100	1,400	yes	
Distant Suns	4.2	Virtual Reality	\$ 99.95	Amiga			—	1MB	—	—	2,000	yes	
Distant Suns	2.0	Virtual Reality	\$ 99.95	Mac	6 or 7		3.5MB	2MB	—	10,000	2,000		3/94
Distant Suns	2.0	Virtual Reality	\$149.95	Mac	6 or 7	X	3.5MB	2MB	—	15 million	—		3/94
Distant Suns	2.0	Virtual Reality	\$ 69.95	PC (386)	Win 3.1		5.5MB	2MB	VGA	9,100	450		4/92
Distant Suns	2.0	Virtual Reality	\$149.95	PC (386)	Win 3.1	X	5.5MB	2MB	VGA	15 million	—		
Earth Centered Universe	1.5	Nova Astronomics	\$ 35	PC (386)	Win		—	700KB	EGA	9,100	10,000	yes	
Expert Astronomer		Expert Software	\$ 49.95	Mac	6.0.4		1.3MB	2MB	—	9,100	110		7/93
Expert Astronomer		Expert Software	\$ 14.95	PC	DOS		no	512KB	CGA	9,100	110		12/92
Expert Astronomer		Expert Software	\$ 14.95	PC	Win 3.1		yes	2MB	VGA	9,100	110		
Genesis	3.0	Lewis-Michaels Eng.	\$ 69.95	PC (286)	DOS		15MB	—	CGA	259,000	7,840	yes	
LodeStar	2.1	Zephyr Services	\$ 89.95	PC	DOS		—	—	CGA	9,000	110		
LodeStar Plus II		Zephyr Services	\$149.95	PC	DOS		no	—	CGA	9,100	7,840	260,000 stars	
LodeStar Pro	1.02	Zephyr Services	\$259.95	PC (286)	DOS	optional	3 MB	2 MB	VGA	9,100	110	yes	10/94
MacStromony	2.0	Eltan Software	\$ 60	Mac	6.0.4		yes	2MB	—	9,100	1,100	yes	
NightSky		Zephyr Services	\$ 79.95	PC	DOS		—	—	CGA	9,000	—	50,000 stars	
PC SKY	1.1	CapellaSoft	\$ 99	PC (286)	DOS		3.2MB	640KB	VGA	178,000	200		8/93
PLAstro		Zephyr Services	\$ 99.95	PC	DOS		2.5MB	—	VGA	9,100	—		
Redshift		Maris Multimedia	\$ 99	Mac	7	X	1.5 MB	4 MB	color	200,000	40,000		9/94
Redshift		Maris Multimedia	\$ 99	Power Mac		X	—	—	—	200,000	40,000		
Redshift		Maris Multimedia	\$ 99	PC	Win 3.1	X	1.5 MB	4 MB	SVGA	200,000	40,000		9/94
Silicon Sky	6.2	Algol Software Works	\$ 12	PC	DOS		—	—	EGA	—	—		
SkyGazer		Carina Software	\$ 79.95	Mac			—	—	—	—	—		
Sky Globe	3.6	KlassM Software	\$ 20	PC	DOS		no	640KB	CGA	29,000	110	yes	
StarGaze	2.1	C.E.B. Metasystems	\$ 99.95	PC	DOS		6MB	640KB	EGA	500,000	9,000	yes	6/93
Superstar	4	picoScience	\$149.95	PC	DOS		10MB	640KB	VGA	259,000	7,800	yes	
Superstar Pro	4	picoScience	\$249.95	PC	DOS		10MB	640KB	VGA	259,000	7,800	yes	
The Cosmos	3.0	Mensys	\$ 89.95	PC (386)	OS/2		4MB	—	VGA	9,100	150		
TheSky level II	2.0	Software Bisque	\$129	PC	Win 3.1		5.5MB	1 MB	VGA	47,000	7,840		5&6/93
TheSky level III	2.0	Software Bisque	\$199	PC	Win 3.1		12MB	1MB	VGA	259,000	13,000		
TheSky level II	5.0	Software Bisque	\$ 99	PC	DOS		5.5MB	—	—	47,000	7,840		
TheSky level III	5.0	Software Bisque	\$175	PC	DOS		12MB	—	—	259,000	13,000		
TheSky GSC	2.0	Software Bisque	\$249	PC	Win 3.1	X	5MB	4MB	—	15 million	80,000		
Visible Universe	6	Parsec Software	—	PC	DOS		4MB	2MB	VGA	—	—	—	
Voyager II		Carina Software	\$159.95	Mac	6 or 7	optional	1.5MB	2MB	—	50,000	4,200	yes	12/93
Voyager		Carina Software	\$124.95	Amiga	—		—	1MB	—	9,100	1,200	yes	

DEEP-SKY PROGRAMS

Program Name	Version	Developer	Price	Comp	System	CD-ROM	H. Drive	Mem	Display	# Stars	# Objects	Opt DB	Rev.
Arizona Database	8.0	Arizona Database	\$ 89.95	PC	DOS		13.5MB	—	—	—	60,000		
Dark Sky	1.0	Arizona Database	\$129.95	PC	Win		—	—	—	259,000	61,000		
Deep Space 3D	3.0	David Chandler	\$ 79	PC	DOS		2.5MB	512KB	CGA	19,600	13,000	yes	4/93
Guide	2.0	Project Pluto	\$ 69	PC	DOS	X	yes	640KB	EGA	15 million	38,000		8/94
HyperSky		Willmann-Bell	\$ 49.95	PC	DOS	optional	2.3MB	500KB	CGA	46,000	5,500	yes	11/92
MegaStar	1.8	E.L.B. Software	\$139	PC (286)	DOS	X	8-54MB	500KB	VGA	15 million	84,383		10/93
MegaStar		E.L.B. Software		PC (286)	Win	X	8-54MB		VGA	15 million	84,383		
NGP	2.5	Gary Williams	F	PC	DOS		2MB	512KB	VGA	—	8,164		1/92
Saguaro Database	6.0	Saguaro Astr. Club	\$ 2	—	—		—	—	—	—	10,000		
SkyBase 2000.0	6.2	SkyBase Software	\$ 64.95	PC	DOS		2MB	512KB	CGA	45,000	13,000	yes	

OBSERVATORY PROGRAMS

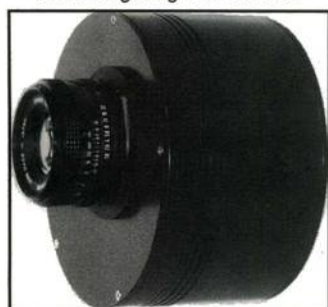
Program Name	Version	Developer	Price	Comp	System	CD-ROM	H. Drive	Mem	Display	# Stars	# Objects	Opt DB	Rev.
AstroSearch		Meade Instruments	\$ 99.95	PC	Win 3.1		yes	640 KB	CGA	—	—		
Epoch 2000	1.04	Farpoint Research	\$329	PC	Win		5MB	640KB	EGA	45,000	13,000		9/93
Personal Observatory		CompuScope	\$399	PC	DOS		—	—	VGA	—	—		
Remote Observing	1.0	Software Bisque	\$299	PC	Win 3.1		yes	—	VGA	—	—		
Sky Pilot		Carina Software	—	Mac	—	—	—	—	—	—	—		
Stars & Scopes		So. Stars Software	\$ 49	Mac	6.0.8		1MB	2MB	—	—	8,000		

An "S" in the "Price" column indicates a shareware program; if you like the program and want to keep it, you pay the developer an amount specified in the program's documentation. An "F" indicates a freeware program; the developer provides this program to the community free. "Display" lists the minimum requirement. The program may support higher video modes. "Opt. DB" indicates whether optional databases are available to extend either the stellar or deep-sky databases. "Rev." indicates in which issue of *Astronomy* a review of the software appeared.

No list of software can be complete since vendors introduce new software every day and multiple versions of some programs exist. No attempt was made to completely tabulate the multitude of shareware programs. We invite any software developer whose products are not contained in any of our tables to send a description of the software to Software Guide, *Astronomy* Magazine, P.O. Box 1612, Waukesha, WI 53187. Review copies of programs are always appreciated.

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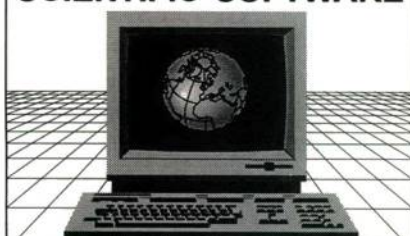
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Top: The rings of Saturn (from the CD ROM version,) and right: the Sun (from the diskette version)



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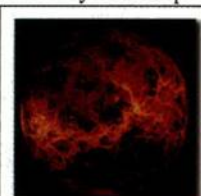


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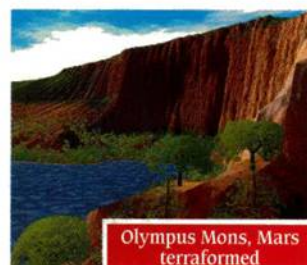
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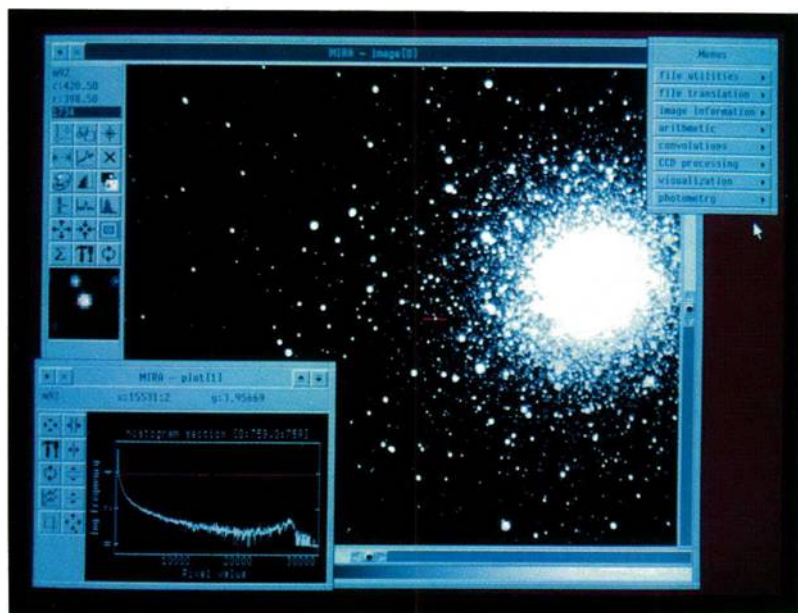
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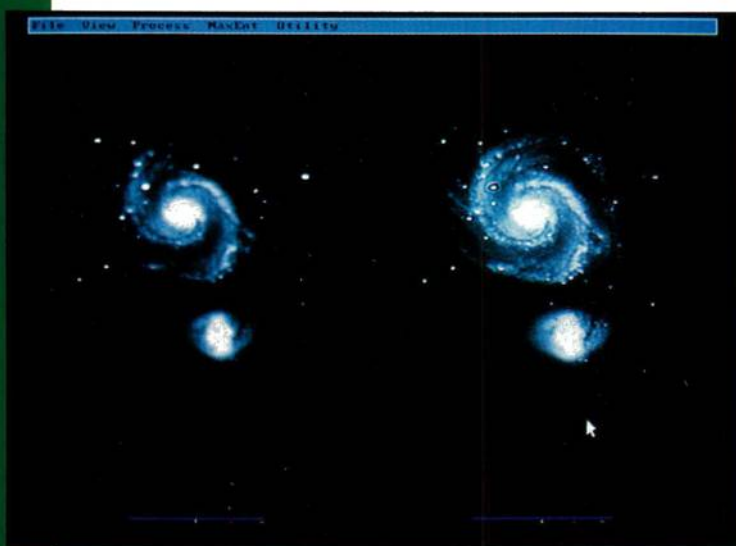
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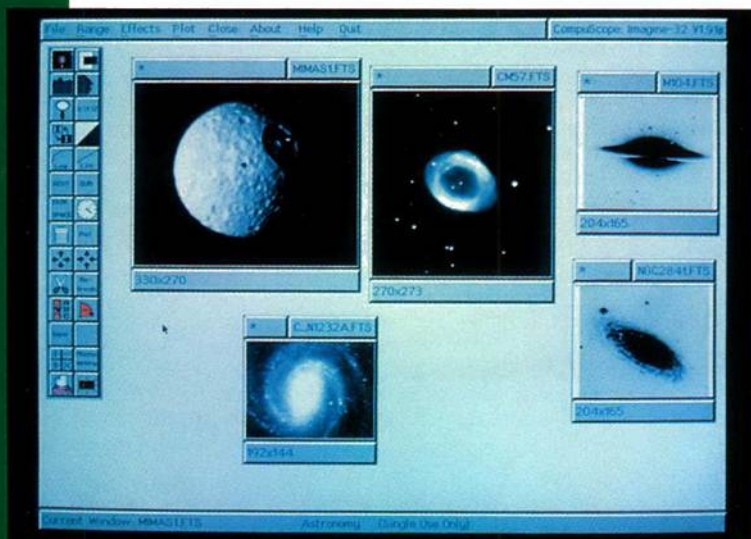
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Mira by Axiom Research



Hidden Image by Sehgal Corp.



Imagine-32 by CompuScope

Take an image, stretch its contrast, increase its brightness, and sharpen its blurry features: that's the genesis of an enhanced image. These same steps could have been performed in a darkroom, but how many astrophotographers have one in this era of one-hour photo processing? Besides, who wants to mix smelly chemicals, worry about the temperature of the developer, and enlarge and dodge many prints until the features of a celestial object come out just right? The digital darkroom is faster, cleaner, more powerful, and a lot more fun.

Most people think about CCD images when they hear the words "image processing," but actually the digital darkroom can enhance any image. Graphics houses (see "Color Separations" in the Yellow Pages) can scan negatives, prints, or slides with a

special reader that converts photos into digital files. Or the local Kodak photo lab can convert the photos to digital images on a Photo CD (you need a CD-ROM drive to read these disks). And armchair astronomers who want to manipulate astronomical photos but don't want to take them themselves, can also obtain many images on CD-ROM (see "Megastorage").

Whatever the source, the fun begins with reading an image into the computer's memory and enhancing the faint features not normally captured with the eyes alone. A dozen-or-so programs are available to choose from ranging in price from about \$30 to \$800. Price considerations should certainly drop the selection down to a handful. Options narrow from there for owners of IBM PC-compatible computers and become even more limited for the Macintosh and Windows environments. Many of the program developers use DOS to reduce the systems requirements on the computer's memory.

Ask developers what video display cards their image-processing software supports. Some support only specific cards because of the requirements of their programs. Others will support almost any VGA or Super VGA card.

Another factor to consider is image format. Not all programs support all of the different image formats such as FITS or the ST6 CCD camera format. And not all programs support color images or the combination (called compositing) of three separate images taken through colored filters into one tricolor image. But more and more of the programs now support tricolor compositing and others will add this feature soon.

Lots of inexpensive programs perform many tasks of image processing, such as calibrating the image using flat field and bias frames and plotting histograms to show the brightness range of an image. Image calibration is an important step because it removes differences in sensitivity between pixels (picture elements, or each element in a CCD array). This step is akin to developing film. Enhancement steps like brightness stretching and sharpening are similar to printing in the darkroom.

Inexpensive programs also provide many of the

basic enhancement functions and filters. Filters are mathematical tools that act in predetermined ways on adjacent pixels. An example is the high-pass filter that suppresses large-scale variations in an image but maintains the small-scale (high frequency) details.

More expensive programs add additional features such as the ability to work on more than one image simultaneously and more powerful math functions, such as Fourier transforms or maximum entropy deconvolution. These latter functions remove the effects of bad seeing or poor guiding from the image. Several programs also work with 32-bit data, which unleashes the full power of an 80386- or 80486-based computer.

Some of the programs are now capable of running a CCD camera, eliminating the need for multiple programs to obtain and process images. All in all, this is probably the fastest-changing area of the astronomical software market. Developers will release several major upgrades and at least one new program by the time this guide reaches your hands.



PhotoShop by Adobe Systems



PhotoStyler by Aldus Corp.



AstrolP from Willmann-Bell

IMAGE-PROCESSING PROGRAMS

Program Name	Version	Distributor	Price	Comp	Sys.	Notes
AstrolP	1	Willmann-Bell	\$ 29.95	PC	DOS	general image processing
CB245PIX		Richard Berry	\$ 49.95	PC	DOS	image processing for TC245 Cookbook camera
Enhance		Owl Computer Serv.	\$189	PC	DOS	general image processing
Hidden Image	1.3	Sehgal Corp.	\$299	PC	DOS	maximum entropy deconvolution routine
Hidden Image 512	1.3	Sehgal Corp.	\$399	PC	DOS	version for ST-6 cameras
Imagine-32	3.0	CompuScope	\$299	PC	DOS	32-bit image processing
Imagine-32 Pro	3.0	CompuScope	\$699	PC	DOS	version with extra filters and Fourier transforms
Improces	3.0	John Wagner	\$ 25	PC	DOS	GIF and PCX image editor
Mira	2.06	Axiom Research	\$595	PC	DOS	powerful 32-bit image processing
MultiPIX		Richard Berry	\$ 39.95	PC	DOS	image compositing for TC211 cameras
PhotoShop	2.5	Adobe Systems	\$895	MAC	6.0.7	image processing for publication
PhotoShop		Adobe Systems	—	PC	Win	general image processing
PhotoStyler	2.0	Aldus Corp.	\$795	PC	Win	image processing for publication
Pixfix		Bruce Johnston	\$ 29.95	PC	DOS	general image processing
SkyPro	1.1	Software Bisque	\$199	PC	Win	general image processing

Accessing large databases has been a stumbling block for many programs until recently. Previously it took dozens of high-density diskettes to hold a stellar database such as the Hubble *Guide Star Catalog* — even large hard disks were overwhelmed with it.

But a more convenient storage medium now provides access to dozens of large databases and hundreds of images without ever putting a strain on hard drives or requiring a floppy shuffle ("Now Insert Diskette #52"). Compact disks can manage up to 700 MB of data within their thin, 12-centimeter diameter. Writing to the disk isn't possible — hence the name "compact disk, read-only memory" and its subsequent acronym (CD-ROM) — but it's probably just as well. If it were, users might accidentally erase or corrupt the database.

Most astronomers and personal computer owners haven't used CD-ROMs until recently because CD-ROM drives were expensive and few astronomy disks existed. But most of the major astronomy software vendors have started to offer programs and databases on CD-ROM and prices for CD-ROM drives continue to drop. In fact, many new home computer systems include a CD-ROM drive.

In addition to their vast storage capability, CD-ROMs are cheap. The Hubble *Guide Star Catalog* with its 19 million objects would cost hundreds of dollars if purchased as a series of books. It's avail-

able on CD-ROM for just \$29.95. Obtaining prints of all the planetary images now available on CD-ROM would prove costly and difficult. And manipulating the printed images is nearly impossible compared to computer processing of digital images. Just be sure your program can read the data format (FITS, PDS, and ARN are the most common ones) for the CD-ROM.

The exciting part is that the disks listed below are just the beginning. Every day astronomers and software vendors are producing new disks. Users will soon wonder how they got along without them.



CD-ROMS ACCESS hundreds of megabytes of data such as images of the planets and catalogs of star and galaxy positions and magnitudes.

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Voyage to the Planets — 2	Astronomical Research Network	\$149.95	ARN	Neptune
Voyage to the Planets — 3	Astronomical Research Network	\$149.95	ARN	Mars
Voyage to the Planets — 4	Astronomical Research Network	\$149.95	ARN	Venus
Voyage to the Stars — 1	Astronomical Research Network	\$149.95	ARN	galaxies
Voyage to the Stars — 2	Astronomical Research Network	\$149.95	ARN	David Malin collection of deep-sky objects
Voyage to the Stars — 3	Astronomical Research Network	\$149.95	ARN	IRAS infrared sky images
Voyage to the Stars — 4	Astronomical Research Network	\$149.95	ARN	Rudy Schild collection of deep-sky objects
Comet Halley, Int'l. Halley Watch	National Space Science Data Center	\$152	FITS, PDS and text	Halley Watch data on 23 disks
IRAS Sky Survey Atlas (ISSA)	National Space Science Data Center	\$ 38	FITS	12.5° x 12.5° images on 4 disks
Pre-Magellan Venus data	National Space Science Data Center	\$ 20	PDS	Radar and gravity data for inner planets on 1 disk
Magellan Venus data	National Space Science Data Center	—	PDS and VICAR2	Radar mosaic images on over 50 disks
Viking Orbiter images of Mars	National Space Science Data Center	\$ 38	PDS	Images on 4 disks
Voyager Spacecraft to Uranus vols 1-3	National Space Science Data Center	\$ 32	PDS	6,538 images on 3 disks
Voyager Spacecraft to Saturn vols 4-5	National Space Science Data Center	\$ 26	PDS	4,000 images on 2 disks
Voyager Spacecraft to Jupiter vols 6-8	National Space Science Data Center	\$ 32	PDS	6,000 images on 3 disks
Voyager Spacecraft to Neptune vols 9-12	National Space Science Data Center	\$ 38	PDS	10,000 images on 4 disks
Joint Education Initiative - earth science	Robert Ridky, Univ. of Maryland	—	PDS	Halley Watch, Voyager, and other data on 3 disks
Space Science Sampler vols 1&2	Randal Davis, Univ. of Colorado	—	PDS	800 Uranus images from Voyager on 2 disks
Space and Astronomy	Walnut Creek CDROM	\$ 39.95	—	1,000 images of Earth, the planets, and space shuttles
Catalogs				
Selected Astronomical Catalogs	National Space Science Data Center	\$ 26	FITS and text	120 catalogs on 2 disks
Principal Galaxy Catalogue	Observatoire de Lyon	\$ 90	—	Information about 73,000 galaxies
Hubble Guide Star Catalog	Astronomical Society of the Pacific	\$ 29.95	—	Positions and magnitudes of over 15 million stars
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Regions of Solar Activity	National Geophysical Data Center	\$111	text	Calcium plage and sunspot group data — 1958 to 1991
Solar Radio Bursts	National Geophysical Data Center	\$111	text	Solar radio emissions
Solar Variability Affecting Earth	National Geophysical Data Center	\$111	text	Flares, spot numbers, and solar irradiance on 1 disk
Interactive Disk				
View from Earth	Warner New Media	\$ 79.98	—	Describes Earth, Sun, and Moon with text and images

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Model ST-5 with CLA-1 Camera Lens

MODEL ST-6 CCD Imaging Camera is an advanced instrument with approximately 9 times the detector area of the ST-4. Its 16 bit dynamic range and low internal noise make it well suited for very low surface brightness objects with large surface areas. The system includes a thermoelectrically cooled CCD head, separate processor/power supply case, cables for power and RS-232 computer interface, Track & Accumulate function, plus extensive imaging, photometry and astrometry software, and Operating Manual.

MODEL CFW-6A Color Filter Wheel allows the user to take tri-color images, co-align them, color balance them, and save them as a merged true color image. Includes servomotor control, six filter positions, red, green, blue and clear interference filters.

MODEL ST-6V CCD Imaging Camera identical to Model ST-6I except with modified CCD detector with quartz optical window for enhanced ultraviolet spectral response out to 200 nm.

MODEL ST-4X CPU Controller upgrade for the Model ST-4. This upgrade significantly improves the imaging performance of the Model ST-4 by increasing the dynamic range to 14 bits, reducing the noise 10X, eliminating the readout structure glow, adding the Track and Accumulate function, and supporting tri-color imaging. The ST-4X Universal CPU also supports Models ST-5 and ST-6 imaging camera heads.

MODEL ST-5 CCD Imaging Camera is an intermediate sized instrument with a detector area between the ST-4 and ST-6. It utilizes a CCD with 10 micron square pixels making it well suited for high resolution imaging. The system includes a thermoelectrically cooled CCD head, separate processor/power supply case, cables for power and RS-232 computer interface, the Track & Accumulate function, plus imaging, photometry, and astrometry software, and Operating Manual.



ST-4X CPU Controller Upgrade



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CCD Imaging Camera Software

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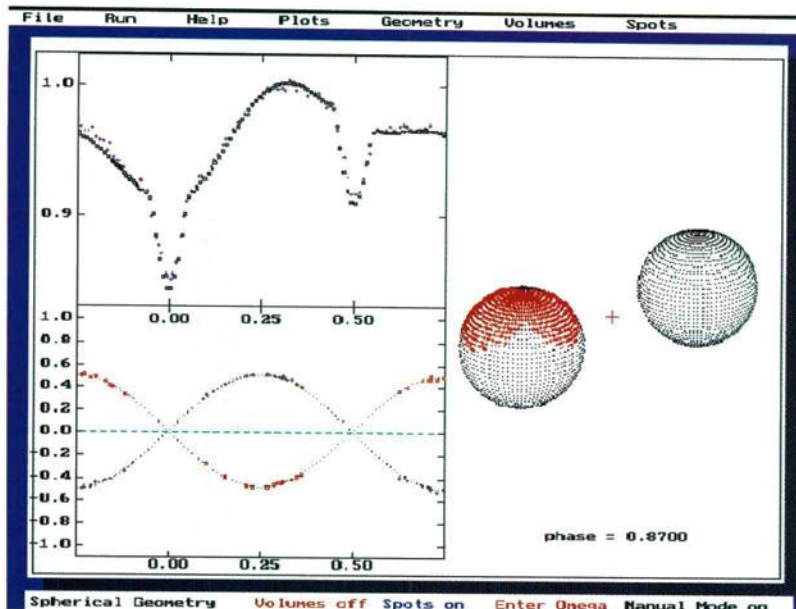
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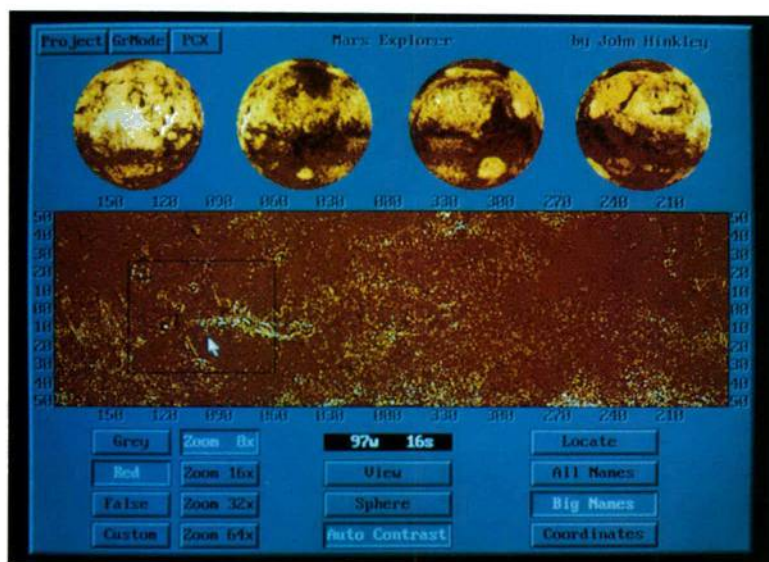
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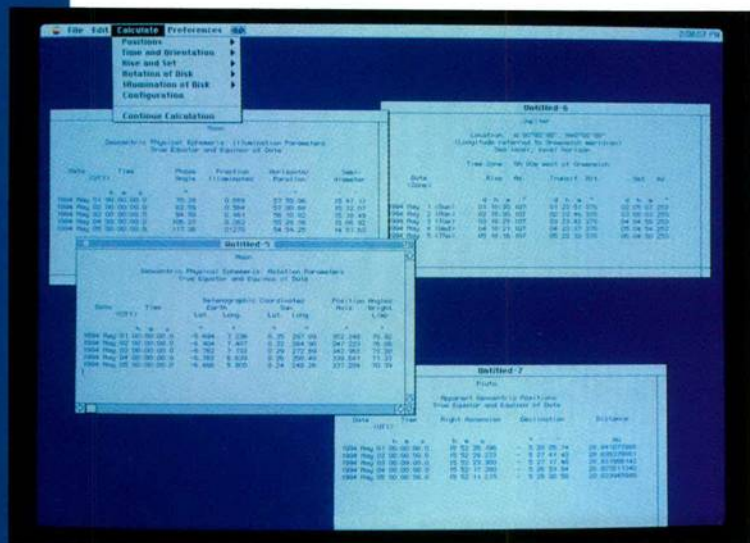
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Binary Maker by Contact Software



Mars Explorer by Virtual Reality



MICA from the National Technical Information Service

Many astronomers think of planetarium-type programs when they think of astronomical computing. But a wealth of special-purpose programs exist that go beyond charting the stars, plotting asteroids, or animating planetary motions. Many of these special-purpose programs tap into other dynamics of astronomy, and some even explore the nature of the universe in ways no other program can.

Eclipse programs will plot the path of a solar eclipse across Earth's face or predict the time of a lunar or solar eclipse more accurately than some planetarium-type programs. The program indicates whether the eclipse will be partial, total, or annular (for solar eclipses) and the precise percentage of coverage, or magnitude, as seen from any given location.

They also determine the limits of visibility of a lunar eclipse or the time of the next solar eclipse in a Saros cycle (the 18-year cycle of similar eclipses).

Orbital programs and gravitational simulators show the motions of two or more stars or galaxies as they move around each other. Both of these kinds of programs reveal what happens to a planet in a binary star system or to two binary star systems that collide. Some of these programs show how two galaxies collide, reproducing the appearance of some actual galaxy pairs such as the Antennae, the Mice, and polar ring galaxies. Or they follow the dynamics of a star system as it coalesces or diffuses into space.

While some special-purpose programs simulate motions, others maintain specialized information. To help observers interested in deep-sky objects, asteroids, and variable stars, these programs maintain and access detailed observing logs, determine the position of an object in a photograph, or track the brightness of a variable star. Brightness variations of eclipsing binary stars are complex, but these programs will show how the stars pass in front of each other and how spots might change the brightness of the star system. Other programs locate a multitude of asteroids and determine their brightnesses.

Several other programs offer relief to astrophotographers attempting to calculate exposure times for different types of objects. These programs can also tell how much sky a lens or telescope-eyepiece combination will cover. They even go so far as to help determine the eyepiece's field of view and which eyepiece will split a close double star.

Need to know when is it best to observe a planet? No problem. There are programs that will calculate a planet's rise and set times and the time it crosses the local meridian. They can also provide the longitude of a planet's central meridian, which is important to know when looking for certain features such as Jupiter's Great Red Spot or Martian volcanoes.

A program can determine the times when the Moon may occult, or pass in front of, a bright star as seen from a given location. Other programs can show observers the positions of the moons of Mars and Jupiter — and the times of possible eclipses and occultations by the planet — before going out to look for them. Knowing the time well in advance can eliminate wasting it later.

Calendars find the dates of the New Moon for planning deep-sky observing sessions or other phases for lunar observing. Other calendar programs translate between different calendrical systems, such as Gregorian, Julian, Chinese, Japanese, Hebrew, and Islamic, which is important for tracing celestial events recorded by ancient astronomers.

Want to build a planet? Software makes it easy to explore what happens to a planet if volcanoes spew too much — or not enough — carbon dioxide into the atmosphere, or if plate tectonics make the continents drift faster than those on Earth. Such simulations demonstrate how life may have differed from its present form or how life might have developed on Mars.

To observe satellites, a multitude of programs will track the orbital paths of the space shuttle and other Earth satellites. These programs list when and where to look to see these objects as they race across the sky. Other programs access the images sent back to Earth by weather satellites, which some amateurs find useful for planning special observing sessions and others enjoy for their picturesque nature. Other space-related programs simulate a spacecraft mission such as Voyager's trip to Jupiter, Saturn, Uranus, and Neptune.

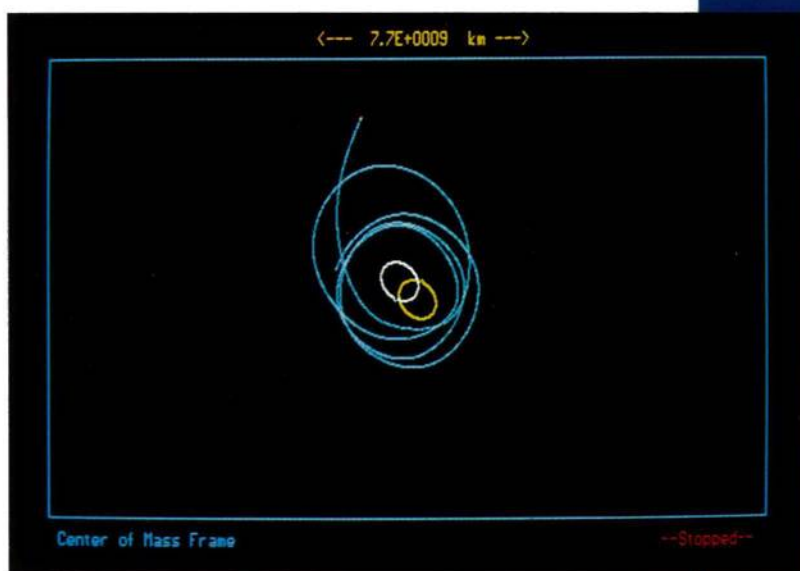
Planetarium-type programs show what the universe looks like from Earth. A few can move off Earth to view the night sky from another planet or a point within the solar system. But a special-purpose program explores the nature of the Local Group of galaxies and how it fits into the local structure of the universe. Another shows the Milky Way Galaxy neighborhood from the vantage point of any star in the region. See how the constellation patterns change as you move through space.

Learn how a telescope works with an optical ray-tracing program. These programs reveal how individual beams of light reflect or refract through a scope's optics. They also distinguish between the types of refracting and reflecting telescopes, including advanced apochromatic and catadioptric telescopes. Different color light rays or rays that pass through different parts of the optics disclose possible aberrations in a scope.

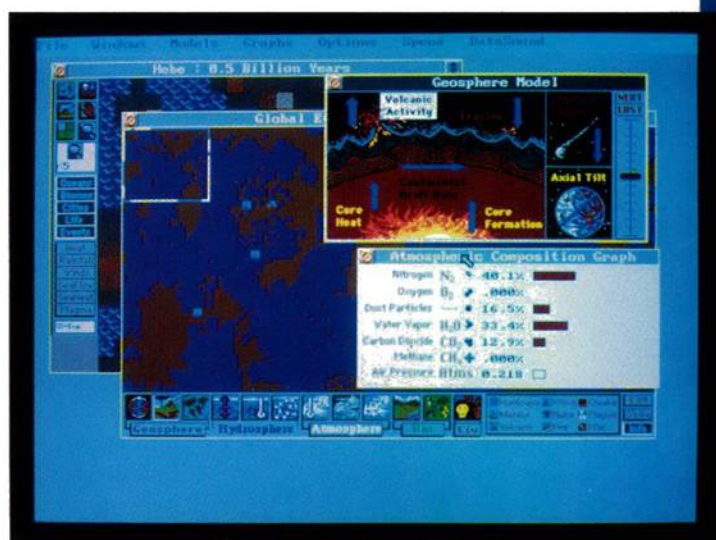
Other programs present the physics of stars and how they emit light or study the intricacies of Einstein's theory of special relativity.

And if all this isn't enough to provide many evenings of enjoyment, various programs include an astronomical encyclopedia that can teach observers about the objects in the night sky. Or for a break from the thoughtful side of astronomy, relax with astronomically oriented games.

If you haven't done so already, put away that planetarium-type program for a while and let these special-purpose programs strut their stuff.



Orbits by Physics Academic Software



SimEarth by Maxis

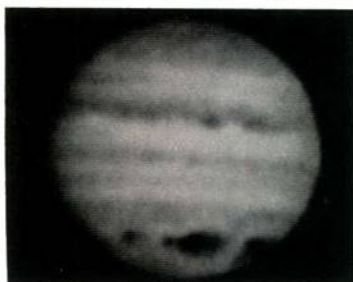


Vista Pro by Virtual Reality

OTHER ASTRONOMY SOFTWARE

Program Name	Developer	Price	Comp	System	H. Drive	Mem	Display	Description
Asteroid Pro	Pickering Anomalies	\$169.95	PC (386)	DOS	40MB	3MB	color	Predicts occultations of stars by asteroids
AstroCalc	Zephyr Services	\$ 30-\$200	PC	DOS	no	—	CGA-EGA	Gives planetary positions, rise and set times
Astronomy Lab	Pers. MicroCosms	\$ 15	PC (286)	Win 3.1	1MB	1MB	—	Predicts astronomical phenomena
Astronomy Workbench	Io Solutions	\$125	PC	DOS	—	—	EGA	Displays the night sky and simulates orbits
AstroPhoto	Zephyr Services	\$ 29.95	PC	DOS	no	—	—	Calculates exposure times
AstroPix	F.C. Meichsner Co.	\$ 39.95	PC	DOS	no	—	—	Computes exposure times for astrophotos
AstroPlanck	Zephyr Services	\$ 29.95	PC	DOS	no	—	VGA	Demonstrates how stars radiate energy
AstroPoint IV	Dale Ferguson	\$ 29.95	PC	DOS	no	—	CGA	Calculates positions of objects in the sky
AstroSheet	C.E.B. Metasystems	\$299.95	PC	Win	—	—	—	Uses Microsoft's Excel for calculations
Astro-3D	Zephyr Services	\$ 30-\$40	PC	DOS	no	—	CGA-EGA	Travels through the Sun's neighborhood
Beam 2	Stellar Software	\$ 89	PC	DOS	no	—	—	Traces light through optical systems
Beam 2	Stellar Software	\$ 89	Mac	—	—	—	—	Traces light through optical systems
Binary Maker	Contact Software	\$ 59.95	PC	DOS	no	640KB	VGA	Simulates binary star orbits and brightnesses
Canon of Eclipses	Willmann-Bell	\$ 29.95	PC	DOS	no	640KB	CGA	Displays lunar eclipses, 1500 B.C.-A.D. 3000
Ceres	Zephyr Services	\$159.95	PC	DOS	7MB	—	EGA	Plots paths for over 5,000 asteroids
CircumSpace	KlassM Software	\$	PC	DOS	no	640KB	EGA	Travels through the Sun's neighborhood
Dark Sky Calendar	Steve Voss	\$ 24.50	PC	DOS	no	—	—	Prints monthly calendar with Moon phases
Discover Space	Brøderbund	\$ 59.95	PC	DOS	—	—	—	Tours the solar system
Eclipse Live	Andrew Lowe	\$ 39.95	PC	DOS	—	—	—	Displays solar eclipses accurately
EclipseMaster	Zephyr Services	\$ 30-\$50	PC	DOS	no	—	—	Computes solar and lunar eclipses precisely
Electronic PictureBooks	Astr. Soc. Pacific	\$ 10-\$40	Mac	7.X	yes	2.5MB	—	Contains images of planets and other objects
GalaxyCrash	Zephyr Services	\$ 30-\$50	PC	DOS	no	—	CGA-EGA	Simulates collision of two galaxies
Galileo's Four	Zephyr Services	\$ 29.95	PC	DOS	no	—	CGA	Shows positions of Jupiter's largest moons
Gauss and Laplace	Andromeda Software	\$	PC	DOS	no	—	—	Computes orbit from three observations
Gravitator	Zephyr Services	\$ 40-\$150	PC	DOS	no	—	CGA-EGA	Computes orbits of stars and planets
Howington Orrery	Zephyr Services	\$ 39.95	PC	DOS	no	—	CGA	Displays orbits in our solar system
JMoons	Andromeda Software	\$	PC	DOS	no	—	EGA	Shows positions of Jupiter's largest moons
Jovian Traveler	Zephyr Services	\$ 49.95	PC	DOS	no	—	CGA	Simulates spacecraft mission to Jupiter
Learn About Orbits	Andromeda Software	\$	PC	DOS	no	—	EGA	Teaches concepts of orbital motion
MarsEGA	Andromeda Software	\$	PC	DOS	no	—	EGA	Locates moons of Mars
Mars Explorer	Virtual Reality	\$ 69.95	PC (386)	DOS	no	4MB	VGA	Maps Mars' surface; need CD-ROM drive
MICA	NTIS	\$ 55	Mac	6.0.2	2MB	1MB	—	Computes precise planetary positions
MICA	NTIS	\$ 55	PC	DOS	2MB	512KB	—	Computes precise planetary positions
MoonTracker	Zephyr Services	\$ 30-\$40	PC	DOS	no	—	CGA-EGA	Displays lunar eclipses and visibility
Optics Lab	Sci. Lab Software	\$ 79	PC (386)	Win. 3.1	644KB	—	—	Traces light through optical systems
Orbits	Soft. Marketing Corp.	\$ 59.95	PC	DOS	no	512KB	EGA	Provides information about the solar system
Orbits	Phy. Acad. Software	\$ 59.95	PC	DOS	no	384KB	CGA	Simulates orbits of stars and planets
Our CosmoHood	Bondano Software	\$ 25	PC	DOS	600KB	—	EGA	Shows our Local Group of galaxies
PC GOES/WEFAX	Soft. Systems Cons.	\$250	PC	DOS	no	640KB	CGA	Captures weather satellite images
PC-Track	Andromeda Software	\$	PC	DOS	no	—	EGA	Tracks Earth satellites
PEEP	C.E.B. Metasystems	\$ 39.95	PC	DOS	yes	640KB	EGA	Finds eclipses, conjunctions, occultations
Personal Observing Log	Ohio Star Software	\$ 20	PC	Win	no	—	—	Records your observing notes
Planets III	Aladdin Software	\$ 39.95	PC	Win	3MB	2MB	—	Shows pictures of and describes the planets
Planet Tracker	David Chandler	\$ 50	PC	DOS	no	512KB	EGA	Investigate the laws of planetary motion
Plate	Zephyr Services	\$ 49.95	PC	DOS	no	—	—	Determines position of object in photo
Satellite Pro	Zephyr Services	\$149.95	PC	DOS	yes	—	EGA	Calculates highly accurate satellite orbits
Satellite Tracker	Intellimation	—	Mac	6.0.5	yes	1MB	—	Tracks Earth satellites
Scope	Waldee-Wood	\$ 49.95	PC	DOS	no	384KB	CGA	Calculates performance of telescope
Silicon Universe	Algol Software Works	\$ 12	PC	DOS	no	—	—	Shows deep-sky objects outside our Galaxy
SimEarth	Maxis	\$ 69.95	Mac	—	—	1MB	—	Creates a planet that then evolves
SimEarth	Maxis	\$ 69.95	PC	DOS	—	640KB	EGA	Creates a planet that then evolves
SkyClock	Bodhi Software	\$ 79.99	PC	DOS	no	512KB	—	Provides rise and set times for planets
Solar	Andromeda Software	\$	PC	DOS	no	—	CGA	Displays solar eclipses from 1951 to 2032
SolarSpace	Zephyr Services	\$ 39.95	PC	DOS	no	—	EGA	Shows Sun's neighborhood in 3D
SolarSys	Zephyr Services	\$ 29.95	PC	DOS	no	—	VGA	Surveys the contents of the solar system
Space Adventure	Knowledge Adventure	\$ 59.95	PC	DOS	7MB	—	VGA	Provides a tour of the universe
Spacetime	Phy. Acad. Software	\$ 59.95	Mac	—	—	—	—	Explores the laws of special relativity
Spacetime	Phy. Acad. Software	\$ 59.95	PC	DOS	no	—	—	Explores the laws of special relativity
StarBase	Altair Engineering	\$199	PC	Win	—	—	—	Stores your observations, images, and text
StarCrossed	Zephyr Services	\$ 29.95	PC	DOS	no	—	VGA	Introduces variable stars
STS-Orbit	Andromeda Software	\$	PC	DOS	no	—	CGA	Displays shuttle orbital paths
SunTracker	Zephyr Services	\$ 30-\$130	PC	DOS	—	—	CGA-EGA	Displays solar eclipses and paths
TideMaster	Zephyr Services	\$ 39.95	PC	DOS	no	—	—	Calculates times of high and low tides
TimeChecker	Zephyr Services	\$ 39.95	PC	DOS	no	—	—	Gets correct time from U.S. Naval Obs.
Total Eclipse	Zephyr Services	\$129.95	PC	DOS	yes	—	EGA	Displays solar and lunar eclipses
TrakSat	Zephyr Services	\$ 89.95	PC	DOS	no	—	CGA	Follows Earth satellites in their orbits
VarBase	Zephyr Services	\$ 29.95	PC	DOS	no	—	CGA	Records and displays variable star data
Vista Pro	Virtual Reality	\$129.95	Mac	DOS	4MB	4MB	color	Creates Martian landscapes from Viking data
Vista Pro	Virtual Reality	\$129.95	PC	Win and DOS	4MB	4MB	VGA	Creates Martian landscapes from Viking data
Where in Space	Brøderbund	\$ 79.95	PC (386)	DOS	8MB	640KB	VGA	Presents a game set in the solar system
WinTrak	WinTrak	\$ 49.95	PC (286)	Win	3MB	2MB	VGA	Tracks Earth satellites

An "S" in the "Price" column indicates that the program is shareware. If you like the program and wish to keep it, you must register your copy with the developer and pay the fee listed with the program documents. "Display" lists the minimum display required. The program may support higher video modes.



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In addition to plotting stars, processing images, and running telescopes, computers keep users in touch with other astronomers. Many clubs and organizations provide a bulletin board service (BBS) so users can dial into their computers and share programs, leave messages on the bulletin board, or "talk" directly to others in a forum or conference. A modem and a communications program is all that is needed. This list provides the phone number and, where known, the data transfer rate (baud rate) and the number of data bits/parity/stop bits needed to set the modem properly. All of these bulletin boards provide free service (although you have to pay the cost of the telephone call); some have additional services, which cost a small amount.

BULLETIN BOARDS

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NASA Spacelink BBS
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300-2400
NASA news, files intended for classrooms and teachers

ALASKA

The Observatory
Anchorage
(907) 277-3508
300-9600
NASA, conferences, software, text files, images

ARKANSAS

Arkansas Astronomy BBS
Little Rock
(501) 569-3001
300-2400
GIF image files, software

Central Arkansas Astronomical Society
Little Rock
(501) 372-1367
up to 14,400, 8/N/1
News, files, messages

CALIFORNIA

Zeke
Del Mar
(619) 755-5675
300-2400
Radio astronomy and SETI

Starbase III
Fresno
(209) 432-2487
300-2400
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Fullerton
(714) 738-4331
300-2400
IAU telegrams, NASA notes, space images

Tri-Valley Stargazers
Livermore
(510) 443-6146

Space Sciences BBS
Newhall
(805) 259-6407
NASA news, images, conferences, software

Ventura County NSS Chapter
Oak View
(805) 649-5314
1200-14400
Space-oriented files and messages

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Pasadena
(818) 354-1333
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JPL news releases, GIF images, educational materials

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1200-2400
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Kingmont Astro Observatory BBS
Sacramento
(916) 652-5920
300-9600
Software

Astronomer's Support BBS
San Diego
(619) 271-6699
2400

Astronomy and space messages, GIF images, astronomy utilities

San Diego Astronomy Association
San Diego
(619) 223-1787

Homer
Tustin
(714) 939-1041
1200-2400
Space files and images

Starbase BBS
Woodbridge
(209) 339-0220
300-2400
Astronomy files and programs

COLORADO

NGDC Solar-Terrestrial Data BBS
Boulder
(303) 497-7319
300-9600, 8/N/1
Sunspot numbers, irradiance, demo software

NOAA BBS

Boulder
(303) 497-5000
Geophysical and solar activity

Space Network
Boulder
(303) 494-8466
Planetary Society Mars Institute; promotion of space exploration

The Comm-Post
Denver
(303) 534-4646
300-14400
Access to astronomy areas free, but \$50/year for other areas

CONNECTICUT

Observer's Database BBS
Old Greenwich
(203) 637-6710
1200-38400
Astronomy and space messages/files

FLORIDA

Space Academy BBS
Cocoa Beach
(407) 799-3267
300-14400
Space databases, GIF images, NASA news, space /astron. software

Sky Net
Jacksonville
(904) 731-8706
Northeast Florida Astronomical Society

Event Horizon BBS
Safety Harbor
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300-14400
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GEORGIA

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300-2400
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JAPAN

The Space Board
Yokohama
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COMMERCIAL ON-LINE SERVICES

Computer networks provide many services for astronomers including electronic mail (e-mail), forums, software downloading, and connections to other networks (such as the Internet) that contain a wealth of information, databases, and software. Many software vendors also check the bulletin boards for user comments

and questions, providing users with assistance with their programs.

All of these services charge usage fees, usually as a base rate plus a connect fee for each hour of use and charges for the use of special services. Connect fees listed are per hour for 9600 baud connections.

Service	Phone	Monthly Fee	Connect Fee	Remarks
America Online	(800) 827-6364	\$9.95	\$3.95	includes 5 free hours with the monthly fee
CompuServe	(800) 848-8199	\$8.95	\$9.60	\$39.95 starting kit, includes software and one month of basic services
Delphi	(800) 695-4005	\$10	\$9	10/4 plan: \$10 for first four hours, and then \$9 per extra hour
Genie	(800) 638-9636	—	—	
National Videotext Network	(800) 336-9096	\$8.95	\$7.50	includes 4 free hours, lower connect fee for use during nonprime hours
Prodigy	(800) 776-3449	\$14.95	—	\$4.95 trial package; astronomy forum incurs extra charge after 2 hours

Adobe Systems Inc., 1585
Charleston Road, Mountain
View, CA 94039-7900, (800)
833-6687

Aladdin Software, 1001 Colfax
Street, Danville, IL 61832,
(217) 443-4611

Aldus Corp., 411 First Avenue
South, Seattle, WA 98104-
2871, (206) 628-2320

Algol Software Works, P.O. Box
6714, Orange, CA 92613

Altair Engineering, P.O. Box 301,
Loma Linda, CA 92354,
(800) 984-4545

Andromeda Software, Inc., P.O.
Box 605, Amherst, NY
14226-0605, fax (716) 691-
6731

ARC Science Simulations, Box
1955A, Loveland, CO 80539,
(303) 667-1168, fax (303)
667-1105

Arizona Database Project, 3131
E. Thunderbird Road #8,
Suite 130, Phoenix, AZ
85032, (602) 992-2813

Astronomical Research Network,
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Maplewood, MN 55117,
(612) 488-5178, fax (612)
487-3074

**Astronomical Society of the
Pacific**, 390 Ashton Avenue,
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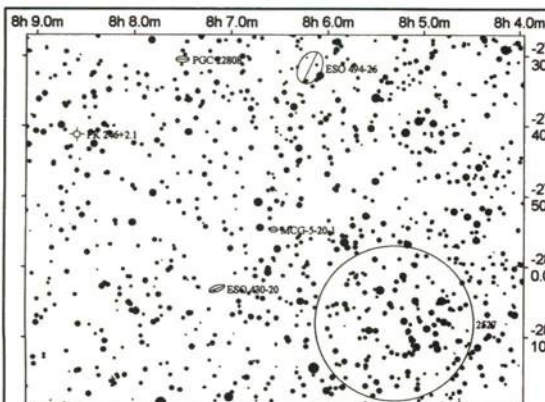
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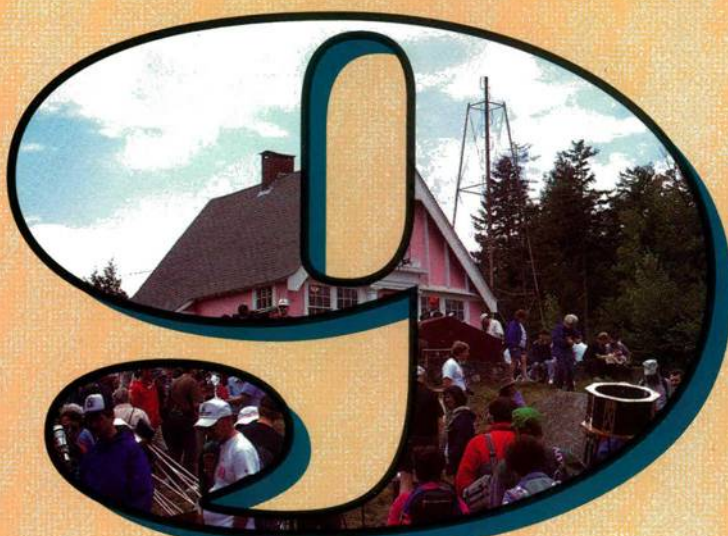
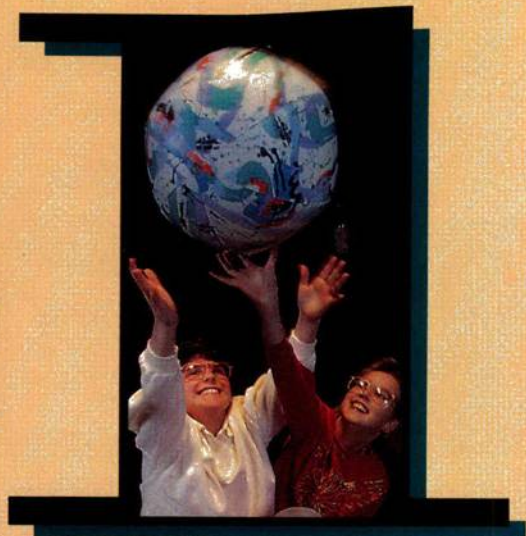
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SPACE PLACES

Your guide to North America's astronomy clubs, organizations, planetariums, and observatories

ASTRONOMY CLUBS AND PLACES

CANADA

ALBERTA

CLUBS

Calgary: RASC—Calgary Chapter, Calgary Centennial Planetarium, P.O. Box 2100, Station M, T2P 2M5, Ruth Lewis, (403) 283-0570, 193 members, observatory, 17.5" scope. Hotline: 273-STAR.

Edmonton: RASC—Edmonton Centre, 11211 142nd St., T6A LK7, Sylvia Smith, 130 members, observatory, 14" SCT.

Fort McMurray: Astronomical Society of Fort McMurray, 113 Auger Ct., T9J 1E5.

Lethbridge: Lethbridge Astronomy Society, P.O. Box 1104, T1J 4A2, Rick Ponomar, (403) 381-1332, 40 members, observatory, 16" scope. Hotline: 381-STAR.

PLACES

Calgary: Alberta Science Centre, 701-11 Street SW, T2P 2M5, (403) 221-3713, 65' dome theater, observatory, exhibits. Open Mon. and Tues. in fall and winter. Program info: 221-3700.

Calgary: Rothney Astrophysical Observatory, University of Calgary, 2500 University Dr., NW, T2N 1N4, (403) 220-5412, observatory, 70" scope. Open by reservation.

Edmonton: Edmonton Space & Science Centre, 11211-142 St., T5M 4A1, (403) 452-9100, 76' dome theater, observatory, 14" SCT, IMAX, exhibits, tours. Open Mon. during winter. Program info: 493-9000.

Edmonton: Campus Observatory, Dept. of Physics,

University of Alberta, T6G 2J1, (403) 492-5287, observatory, 14" SCT, exhibits. Open Fri. evenings. Program info: 492-5410.

BRITISH COLUMBIA

CLUBS

Clearbrook: Fraser Valley Astronomers Society, 2659 Valemont Crescent, V2T 3V6, J.V. Pollack, (604) 850-3931, 20 members.

Comox: Comox Valley Astronomy Club, 1467 Balmoral Ave., V9N 7N9, Keith Finnie, (604) 339-3720, 25 members, 8" scope.

Port Coquitlam: Port Coquitlam Astronomy Club, 2256 Fraser Ave., V3B 1N9, Ted Littlewood, (604) 942-9382, 25 members.

Prince George: Prince George Astronomical Society, College of New Caledonia, 3330-22nd Ave., V2N 1P8, Bob Nelson or Orla Aauquist, (604) 964-3600, 40 members, observatory, 24" scope.

Vancouver: RASC—Vancouver Centre, Gordon Southam Observatory, 1100 Chestnut St., V6J 3J9.

Vernon: Okanagan Astronomical Society, 4100 25th Ave., V1T 1P4, Peter Kuzel, (604) 545-1226.

Victoria: RASC—Victoria Centre, 354 Ben Homer Dr., V9C 2C6, Bill Almond, (604) 385-4302, 130 members. Hotline: (416) 724-7827.

PLACES

Penticton: Dominion Radio Astrophysical Observatory, Box 248, V2A 6K3, (604) 493-2277, exhibits, tours. Program info: 490-4355.

Vancouver: H.R. MacMillan Planetarium & Gordon Southam Observatory, 1100 Chestnut St., V6J 3J9,

(604) 736-4431, 65' dome theater, observatory, 20" SCT, exhibits, tours. Open Mon. (Sept.-June). Program info: 736-3656.

Vancouver: Science World British Columbia, 1455 Quebec St., V6A 3Z7, (604) 687-8414, OMNIMAX, exhibits. Program info: 268-6363.

Vancouver: University of British Columbia Observatory, 2219 Main Mall, V6T 1W5, (604) 228-2802, observatory, 16" scope. Program info: 228-6186.

Victoria: Climenhaga Observatory, University of Victoria—Dept. of Physics, Box 3055, V8W 3P6, (604) 721-7750, observatory, 20" SCT. Open by reservation.

Victoria: Dominion Astrophysical Observatory, V8X 4M6, (604) 363-0001, observatory, 72" reflector, exhibits, tours. Open daily. Program info: 363-0012.

MANITOBA

CLUBS

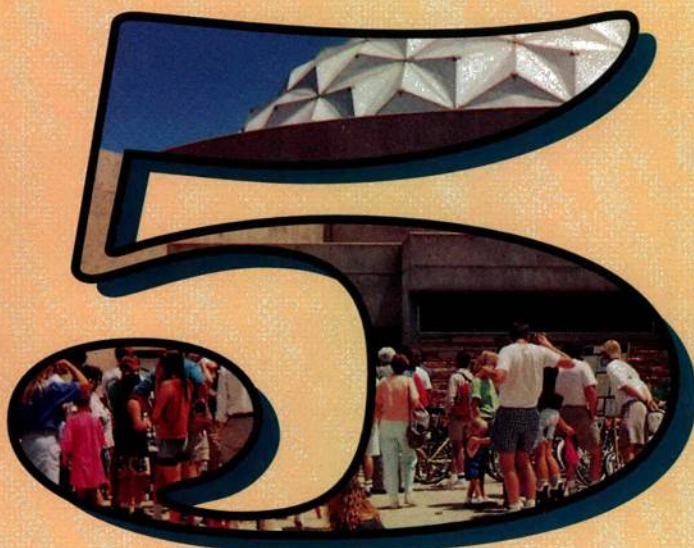
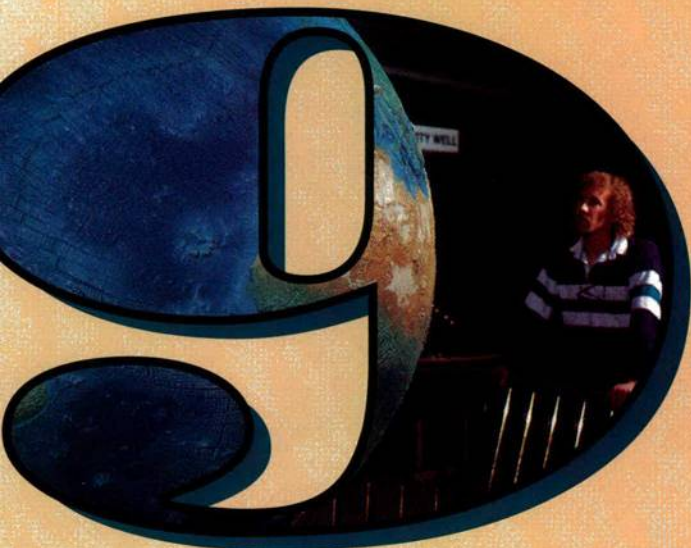
Brandon: West-Man Astronomy Club, 32 Ashgrove Blvd., R7B 1C2, Jeff Harland, (204) 727-3111.

Winnipeg: Manitoba Astronomy Club, 190 Rupert Ave., R2H 1S5, Gilbert Valentin, 12.5" scope.

PLACES

Winnipeg: Lockhart Planetarium, University of Manitoba, 390 University College, 500 Dysart Rd., R3T 2M8, (204) 474-9785, 26' dome theater. Open by reservation.

Winnipeg: Manitoba Planetarium, 190 Rupert Ave., R3B 0N2, (204) 956-2830, 60' dome theater. Program info: 943-3142.



NEW BRUNSWIC

CLUBS

Hampton: Hampton Astronomy Club, Malcolm Baxter, (506) 832-4797.
St. John: Saint John Astronomy Club, 390 Kingsville Rd., E2M 4T2, Adren Bordage.

NEWFOUNDLAND

CLUBS

St. John's: RASC – St. John's Centre, 206 Frecker Dr., A1E 5H9, Randy Dodge, (709) 745-2903, 40 members, 12.5" scope. Hotline: 754-5635.

NOVA SCOTIA

CLUBS

Halifax: RASC – Halifax Centre, 1747 Summer St., B3H 3A6, Nat Cohen or David Lane, (902) 434-3103, 150 members, 17" scope.
Sydney River: Cape Breton Astronomical Society, 131 Green Acres Dr., B1S 1K5, John Reppa, (902) 562-2772.

PLACES

Halifax: Burke-Gaffney Observatory, Saint Mary's University, B3H 3C3, observatory, 16" SCT. Open by reservation. Program info: (902) 420-5633.
Halifax: Halifax Planetarium, Nova Scotia Museum, Summer St., B3H 3A6, (902) 429-4610. Open by reservation.

ONTARIO

CLUBS

Kingston: RASC – Kingston Centre, P.O. Box 1793, K7L 5J6, Walter MacDonald, (416) 579-6615, 65 members, 10" scope.
London: International Meteor Organization (North America), University of Western Ontario, N6A 3K7, Peter Brown, (519) 474-1941, 200 members.
London: RASC – London Centre, P.O. Box 842, Station B, N6A 4Z3, Eric Clinton, (519) 453-3198.
Mooretown: RASC – Sarnia Centre, 1091 Emily St., N0N 1M0, Alice Lester, (519) 867-5379, 15 members.
Niagara Falls: RASC – Niagara Centre, P.O. Box 241, L2E 6T3, Charles Fassel, (416) 935-3227, 45 members, observatory, 17.5" scope.
North Bay: North Bay Astronomy Club, 50 Van Horne Crescent, P1A 3L3, Merlin Clayton, (705) 472-1182, observatory, 16" scope.
North York: Students for the Exploration and Development of Space, York Student Centre, 4700 Keele St., M3J 1P3, H. Peter White, (416) 650-9890, 100 members.
Ottawa: RASC – Ottawa Centre, P.O. Box 6617, Station J, K2A 3Y7, Douglas George, (613) 225-7182, 250 members, observatory, 16" scope.
Scarborough: Metropolitan Toronto Astronomical Society, 154 John Taber Trail, M1B 2P8, S. Spinney.
Sudbury: Sudbury Astronomy Club, 859 Chestnut Crescent, P3A 5B3, Fred Boyer, (705) 560-3265.
Thunder Bay: RASC – Thunder Bay Centre, 135 Hogarth St., P7A 7H1, Bob Bishop, (807) 767-5689, 38 members.
Toronto: North York Astronomical Association, 26 Chryssa Ave., M6N 4T5, Andreas Gada, (416) 761-1798, 50 members, observatory, 16" scope.
Toronto: RASC – Toronto Centre, McLaughlin Planetarium, 100 Queen's Park, M5S 2C6, Tony Horvatin. Founded in 1868, 800 members. Hotline: (416) 724-STAR.

Waterdown: RASC – Hamilton Centre, P.O. Box 1223, L0R 2H0, Patricia Marsh, (416) 575-4191, 90 members, observatory, 17.5" scope.
Waterloo: RASC – Kitchener-Waterloo Centre, 114 Westvale Dr., N2T 1J2, Paul Bigelow, (519) 888-7516, 30 members, observatory, 12.5" scope.
Windsor: RASC – Windsor Centre, 5450 Haig Ave., N8T 1K9, Joady Ulrich, (519) 945-3132, 45 members.

PLACES

Hamilton: W.J. McCallion Planetarium, McMaster University, 1280 Main Street West, L8S 4M1, (905) 525-9140 ext 27777, 24' dome theater. Open by reservation.
Ottawa: National Museum of Science & Technology, 1867 St. Laurent Blvd., K1G 5A3, (613) 991-9219, 16' dome theater, observatory, 15" refractor. Open Tues. (French) and Wed. and Thurs. (English).
Richmond Hill: David Dunlap Observatory, University of Toronto, P.O. Box 360, 123 Hillview Dr., L4C 4Y6, observatory, 74" reflector, tours, exhibits. Open by reservation. Program info: (905) 884-2112.
Sudbury: Science North Solar Observatory, 100 Ramsey Lake Rd., P3E 5S9, (705) 522-3701, observatory, 10" SCT, exhibits, IMAX.
Toronto: McLaughlin Planetarium, Royal Ontario Museum, 100 Queen's Park, M5S 2C6, 75' dome theater, exhibits. Program info: (416) 586-5736.
Toronto: Ontario Science Centre, 770 Don Mills Rd., M3C 1T3, (416) 429-4100, 24' dome theater, exhibits. Program info: 696-3127.

PRINCE EDWARD ISLAND

CLUBS

Summerside: Athena Community Astronomy Club, P.O. Box 1432, C1N 4K2, (902) 436-4720, 26 members, observatory, 10" scope.

QUÉBEC

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Drummondville: Club d'Astronomie Drummondville, C.P. 53, J2B 6V6, Ghislain Chagnon, (819) 472-5760.
La Pocatière: Club d'Astronomie, 140 4e Ave., G0R 1Z0, Louis Théberge, (418) 856-1525.
La Salle: Les Observateurs de la Magnitude Absolue, 9070 rue Boivin, H8R 2E4, Gaëtan Cormier, 100 members. Hotline: (514) 367-0138.
Laval: Club des Astronomes Amateurs de Laval, C.P. 214, Succ. Saint-Martin, H7V 3P5, Jean-Marc Richard, (514) 625-5527, 100 members.
Longueuil: Club des Astronomes Amateurs de Longueuil, 941 des Pinsous, app. 305, J4G 2L8, Gerald Brassard, (514) 466-1177, 30 members, 20" scope.
Montréal: Association des Groupes d'Astronomes Amateurs, 4545 Pierre-de-Coubertin, C.P. 1000, Succ. M, H1V 3R2, Jean-Marc Richard, (514) 252-3038, 700 members, 20" scope.
Montréal: RASC – Le Société d'Astronomie de Montréal, P.O. Box 206, Station St. Michel, H2A 3L9, Marc André Gélinas, (514) 728-4422, observatory, 8" scope.

Montréal: RASC – Montréal Centre, P.O. Box 1752, Station B, H3B 3L3, Louie Bernstein, 130 members, observatory, 14" scope. Hotline: (514) 848-2612.

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Trois-Rivières-Ouest: Club d'Astronomie Jupiter, Inc., 3601 Pontoise, G8Y 4M3, Thomas Collin, (819) 373-0266, 20 members, 16" scope.

Valleyfield: Club d'Astronomie Orion, 409, rue Jacques-Cartier, J6T 4T7, Yvan Prigent, (514) 377-2493.

PLACES

Montréal: Planetarium de Montréal, 1000, St. Jacques Ouest, H3C 1G7, 65' dome theater, exhibits. Open daily Dec. 24-Jan. 8, June 18-Sept. and Tues.-Sun. the rest of the year. Program info: (514) 872-4530.
Notre Dame Des Bois: Mont Mégantic Observatory, Chemin de Lamontagne, J0B 2E0, (819) 888-2755, exhibits, tours. Open in summer.

SASKATCHEWAN

CLUBS

Regina: RASC – Regina Centre, Box 20014, 2102 11th Ave., S4S 7E6, (306) 352-8515, observatory, 16" scope.
Saskatoon: RASC – Saskatoon Centre, Box 317, RPO University, S7N 4J8, Richard Huziak, (306) 665-3392, 52 members, observatory, 12.5" scope.

PLACES

Eastend: Wilkinson Memorial Observatory, P.O. Box 520, S0N 0T0, (306) 295-3322, observatory, SCT, tours. Open by reservation.
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Saskatoon: University of Saskatchewan Observatory, University Campus, S7N 0W0, (306) 966-6396, observatory, 6" refractor. Open Sun.-Fri. Program info: 966-6429.

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CLUBS

Auburn: Auburn Astronomical Society, 748 E. Magnolia Ave., 36830, Jim Chestnutt, (205) 821-1062.

Birmingham: Birmingham Astronomical Society, P.O. Box 36311, 35236, Bob Braeunig, (205) 991-0862, 54 members, observatory, 16" scope.

Huntsville: Von Braun Astronomical Society, Box 1142, 35807, Dennis Culver, (205) 539-0316, 150 members, observatory, 21" scope. Hotline: 536-9561.

Mobile: Mobile Astronomical Society, P.O. Box 160972, 36616-1972, Pat Rochford, 40 members, observatory, 12.5" scope.

Tusculum: Muscle Shoals Astronomical Society, 302 N.E. Commons, 35674, Homer Russell, Jr., (205) 383-6719, 10 members, observatory, 10" scope.

PLACES

Birmingham: Robert R. Meyer Planetarium of Birmingham Southern College, 900 Arkadelphia Rd., 35254, (205) 226-4770, 30' dome theater. Program info: 226-4771.

Florence: University North Alabama Observatory, 5150 Una, 35632, 30' dome theater, observatory, 14" reflector. Open daily, except for 3 nights per week. Program info: (205) 760-4284.

Huntsville: The Space and Rocket Center, One Tranquility Base, 35807-7015, OMNIMAX, exhibits, tours. Program info: (205) 837-3400.

Jacksonville: Jacksonville State University Planetarium, North Pelham Rd., 36265, (205) 782-5616, 20' dome theater, observatory, 12.5" scope.

ALASKA

CLUBS

Anchorage: Anchorage Astronomical Society, 3539 Dunkirk Dr., 99502, John Morrow, (907) 269-5744.

Anchorage: Astronomical Society of Alaska, 2500 Sebring Circle, 99516, Richard Pellessier, (907) 345-8468, 40 members, observatory, 18" Dobsonian.

Fairbanks: Astronomical Units, Box 82210, 99708, Robert E. Fischer, (907) 456-6586, observatory, 14" scope.

PLACES

Fairbanks: Geophysical Institute, University of Alaska-Fairbanks, Elvey Building, 99775.

Juneau: Marie Drake Planetarium, 10014 Crazy Horse Dr., 99801, (907) 463-1899. Program info: 586-3278.

ARIZONA

CLUBS

Cottonwood: Verde Valley Astronomy Club, 822 N. 7th St., 86326, Barbara Westhafer, (602) 634-3187, 30 members.

Grand Canyon: Astronomical Society of the Grand Canyon, P.O. Box 1515, 86023, Larry Noon, (602) 638-2263, 7 members.

Green Valley: Sonora Astronomical Society, 101 Verde Vista, 85614, Robert Andress, (602) 625-8324, 60 members.

Mesa: East Valley Astronomy Club, 507 E. Ivy, 85203, Ted Heckens, (602) 827-1524, 100 members.

Mesa: Leisure World Astronomers, 1792 Leisure World, 85206, Bud Ridley, (602) 981-3136.

Mesa: Phoenix Astronomical Society, 1021 S. Revere, 85202, Andy Castillo or Leon Knott, (602) 461-1758, 75 members.

Phoenix: Phoenix Youth Astronomical Network, 3744 W. Brown, 85051-1140, John Barentine, (602) 843-5896, 8 members.

Phoenix: Saguaro Astronomy Club, 19026 N. 34th Dr., 85027, Robert Dahl, (602) 582-5526, 120 members.

Prescott: Prescott Astronomy Club, 1848 Emerald Dr., 86301.

Sierra Vista: Huachuca Astronomy Club, 3395 Briarwood Dr., 85635, Ray Perger, 485-9774, 19 members.

Sun City West: Astronomy Club of Sun City West, 17802 131st Ave., 85375, Jim Crisman, (602) 584-0896, 150 members.

Tucson: Tucson Amateur Astronomy Association, P.O. Box 41254, 85717, Dean Ketelson, (602) 293-2855, 200 members, observatory, 16" scope.

PLACES

Amado: Multiple Mirror Telescope Observatory, P.O. Box 97, 85645, (602) 670-6741.

Flagstaff: Braeside Observatory, P.O. Box 906, 86002, (602) 774-4222. Open by reservation.

Flagstaff: Lowell Observatory, 1400 W. Mars Hill Rd., 86001, (602) 774-3358, observatory, 24" refractor (Clark), exhibits, tours. Program info: 774-2096.

Flagstaff: Northern Arizona University Campus Observatory, Dept. of Physics & Astronomy, Box 6010, 86011-6010, (602) 523-2661, observatory, 24" reflector.

Flagstaff: U.S. Naval Observatory, P.O. Box 1149, 86002, (602) 527-7000.

Tucson: Flandrau Science Center, University of Arizona, Corner of Cherry and University Blvd., 85721, (602) 621-4515, 50' dome theater, observatory, 16" reflector, Cinema 360°. Program info: 621-STAR.

Tucson: Kitt Peak National Observatory, HC 04 Box 7520, 85735-9734, (602) 740-2426, observatory, 158" scope. Program info: 325-9200.

Tucson: Steward Observatory, University of Arizona, 85721, (602) 621-2288.

ARKANSAS

CLUBS

Dover: River Valley Stargazers, 20 Rolling Green Dr., P.O. Box 261, 72837, Rex McDaniel, (501) 331-3620, 18 members, observatory, 20" scope.

Fayetteville: Astronomical Society of Northwest Arkansas, 2503 Sweetbriar Dr., 72703, Betty Davis, (501) 442-2833, 29 members.

Fort Smith: Arkansas-Oklahoma Astronomical Society, P.O. Box 31, 72901, Bob Moody, 40 members, 29" scope. Hotline: (501) 474-4740.

Heber Springs: Association of Lunar and Planetary Observers, P.O. Box 143, 72543-0143, Harry Jamieson, (501) 362-7624, 600 members.

Hot Springs Village: Village Star Gazers Society, 13 Tarifa Ln., 71909, Dorothy Kegerreis/ Jim Drumwright, (501) 922-3068, 25 members.

Roland: Central Arkansas Astronomical Society, P.O. Box 38, 72135-0038, Bruce McMath, (501) 664-2662, 42 members, observatory, 8" scope. Hotline: 372-1367.

PLACES

Fayetteville: University of Arkansas Planetarium, 117 Physics Building, 72701, (501) 575-2506, 20' dome theater, observatory, 16" SCT.

Little Rock: University of Arkansas-Little Rock Planetarium, 2801 South University Ave., 72204, (501) 569-3259, 40' dome theater, observatory, 14.5" SCT. Program info: 569-3277.



CALIFORNIA

CLUBS

Apple Valley: Bear Valley Astronomical Society, 15191 Nokomis Rd., 92307.

Apple Valley: High Desert Astronomical Society, P.O. Box 3968, 92307, Jim Young or Dave Meyer, (619) 245-8020, 70 members, observatory, 14" scope. Hotline: 242-3514.

Aptos: Cabrillo Observatory Club, Cabrillo College, 6500 Soquel Dr., 95003, observatory.

Arcata: Arcata Society for Amateur Astronomers, 3211 Alice Ave., 95521.

Bakersfield: Kern Astronomical Society, 1811 Forest St., 93304, Charles Brown, (805) 322-6496.

Chatsworth: Celestial Observers, 9534 Gierson Ave., 91311-4737, Michael Selden, (818) 882-6172.

Costa Mesa: Orange County Astronomers, 2195 Raleigh Ave., 92627, John Sanford, (714) 722-7900, observatory, 22" scope.

Davis: Univ. of California Davis Astronomy Club, Physics Dept., Univ. of California, 95616, Glen Erickson, (916) 752-1500.

Eureka: Astronomers of Humboldt, College of the Redwoods, 95501, Les Clendenning, (707) 826-3276.

Fallbrook: Oceanside Photo and Telescope Astronomical Society, 929 Buena Rosa Ct., 92028, Penny Hauck, (619) 723-0684.

Fresno: Central Valley Astronomers, P.O. Box 5013, 93755, Clarence Funk, (209) 291-7879, 60 members.

Glen Ellen: Valley of the Moon Astronomical Society, P.O. Box 999, 95442, Al Hepp, (707) 996-1246, 16 members, observatory, 40" scope.

Goleta: Santa Barbara Astronomy Club, 6409-A Camino Vista, 93117, Clyde Kirkpatrick, (805) 966-3695, 50 members, observatory, 16.5" scope.

Hemet: Hemet Astronomical Society, 334 Hillview Dr., 92544, Ralph L. Shook.

Hollywood: Sidewalk Astronomers, 1946 Vedanta Place, 90068, Pam Reid, (310) 696-8792, 150 members.

Idyllwild: Idyll-Gazers Amateur Astronomy Club, P.O. Box 1245, 92549, Joe Neu, (909) 659-3562, 62 members, 29" scope.

Lake Arrowhead: Mountain Skies Astronomical Society, P.O. Box 1169, 28200 Hwy 189 F-240 #31, 92352, Lorann Parker, (909) 337-4075, 1,344 members. Hotline: 336-1299.

Lakewood: Excelsior Telescope Club, St. Pancratius Catholic Church, 3519 St. Pancratius Place, 90712, Fr. Ronald Royer, (310) 634-6111, 30 members, observatory, 18" scope.

Lancaster: Antelope Valley Astronomical Society, P.O. Box 426, 93534, Steve Lantman, (805) 727-0016, 25 members.

Livermore: Tri-Valley Stargazers, P.O. Box 2475, 94551, Richard Green, (510) 449-2190, 152 members, observatory, 17.5" scope.

Lompoc: Vandenberg Amateur Astronomical Society, P.O. Box 5321, 93437, Billy McCabe, (805) 736-4757, 453 members, observatory, 14" scope.

Los Angeles: Los Angeles Astronomical Society, 2800 East Observatory Rd., 90027, Eugene H. Hanson, (818) 344-4846, 350 members, observatory, 31" scope. Hotline: (213) 727-7909.

Martinez: Mt. Diablo Astronomical Society, 1416 Flintwood Ct., 94553, Joseph A. Heckenbach, (510) 224-3417, 85 members.

Mill Valley: Marin Stargazers, 27 Morning Sun, 94941.

Modesto: Modesto Jr. College Astronomy Club, Modesto Jr. College, College Ave., 95350, Bill Luevke, (209) 575-6284.

Monterey: Monterey Institute for Research in Astronomy, P.O. Box 1551, 93942, Stew Hobson, (408) 373-7560, 37 members, 18" scope.

Mountain View: Peninsula Astronomical Society, Foothill College Observatory, P.O. Box 4542, 94040, Brian Day, (408) 286-4997.

Murrieta: Temecula Valley Astronomers, P.O. Box 986, 92564, Doug Pifer, (909) 677-1148, 30 members.

Newhall: Local Group Astronomy Club of Santa Clarita Valley, 25032 Walnut St., 91321-1013, LaVerne Booth, (805) 259-3284, 80 members.

Oakland: Astronomical Association of Northern California, c/o Chabot Observatory, 4917 Mountain Blvd., 94619-3014, Alan Gorski, (510) 376-3007, umbrella organization for 25 clubs. Hotline: 443-6146.

Oakland: Chabot Telescope Makers Workshop, 4917 Mountain Blvd., 94619, Paul Zurawski, (510) 447-6837, 2,000 members.

Oakland: Eastbay Astronomical Society, 4917 Mountain Blvd., 94619, Carter Roberts, (510) 524-2146, 1,810 members, 20" scope.

Palm Desert: Astronomical Society of the Desert, College of the Desert, 43-500 Monterey Ave., 92260, Ashley Thomas McDermott, (619) 346-2524, 55 members.

Pasadena: Mount Wilson Observatory Association, 813 Santa Barbara St., 91101.

Pasadena: Students for the Exploration and Development of Space, 112-58 Caltech, 91125, Ben McCall, (818) 395-2902, 100 members.

Rancho Cucamonga: Riverside Telescope Makers Conference, Inc., c/o Fox & Stephens, CPA's, 9045 Haven Ave., Suite 109, 91730, Robert Stephens. Hotline: (909) 948-2205.

Richmond: Hercules Stargazers, 6102 Sacramento Ave., 94804, David Harris, 11 members. Hotline: (510) 526-5974.

Ridgecrest: China Lake Astronomical Society, P.O. Box 1783, 93555, Roger Brower, (619) 375-3697, 70 members.

Riverside: Riverside Astronomical Society, P.O. Box 51222, 92517-2222 Steven Meyering, 160 members. Hotline: 689-0116.

Rocklin: Sacramento Valley Astronomical Society, P.O. Box 575, 95677, Larry Harrison, (916) 726-7300, 225 members, observatory, 16" scope.

San Bernardino: San Bernardino Valley Amateur Astronomers, 1345 Garner Ave., 92411, David E. Garcia, (909) 884-0657, 70 members.

San Diego: San Diego Astronomy Association, P.O. Box 23215, 92193, Frank Santore, 310 members, observatory, 22" scope. Hotline: (619) 495-1787.

San Diego: San Diego LS Society, P.O. Box 4636, 92164, Leonard McVicker.

San Francisco: San Francisco Amateur Astronomers, c/o Morrison Planetarium, California Academy of Science, Golden Gate Park, 94118, Bob Levinson, (415) 905-6445, observatory, 25" scope.

San Francisco: San Francisco Sidewalk Astronomers, 1801 Golden Gate Ave., 94115, Linda Strite, (415) 567-2063.

San Francisco: S.T.A.R.S., City College of San Francisco, 50 Phelan Ave., 94112, Don Warren, (415) 239-3242, observatory, 14" scope.

San Jose: San Jose Astronomical Association, 3509 Calico Ave., 95124, Jim Van Nuland, 200 members. Hotline: (408) 559-1221.

San Juan Bautista: Fremont Peak Observatory Association, P.O. Box 1110, 95045-1110, Rick Morales, (408) 623-4255, 175 members, observatory, 30" scope. Hotline: 623-2465.

San Luis Obispo: Central Coast Astronomical Society, P.O. Box 1415, 93406, Lee Coombs, (805) 466-2788, 70 members.

San Marcos: Astronomical Society of Southern California, P.O. Box 2046, 92069, Michael Wartenberg, (619) 741-6128.

San Mateo: San Mateo Astronomical Society, P.O. Box 974, Station A, 94403, Michael Maiman, (415) 591-3370, 50 members.

San Rafael: Mount Tamalpais Observers, 89 Dominican Dr., 94901-1337, Tinka Ross, (415) 454-4715.

Santa Barbara: Astronomical Unit, 2559 Puesta del Sol Rd., 93105, Fred Marshak, (805) 682-4711 x 326, 185 members, observatory, 29" scope. Hotline: 682-3224.

Santa Cruz: Santa Cruz Astronomy Club, L-2 San Carlos Ln., 95065, Paul Preto, (408) 335-5008, 80 members. Hotline: 335-2423.

Santa Monica: Santa Monica Amateur Astronomy Club, 1415 Michigan Ave., 90404, Robert Lozano, (310) 450-1944, 40 members.

Santa Rosa: Sonoma County Astronomical Society, P.O. Box 183, 95402, Ed or Cindy Megill, (707) 795-7829, 200 members.

Simi Valley: Ventura County Astronomical Society, P.O. Box 982, 93062, Hal Jandorf, 102 members, observatory, 16" scope. Hotline: 529-7813.

Sonoma: Sonoma Astronomical Society, 21581 Phoenix Lake Road #4, 95370, Lance Kearns, (209) 536-0344, 30 members, observatory, 8" scope.

Stockton: Stockton Astronomical Society, P.O. Box 243, 95201, Ed Rible, (209) 474-5051, 70 members.

Torrance: South Bay Astronomical Society, c/o Microcosm, 2601 Airport Dr., Suite 320, 90505, James R. Wertz, (310) 539-9444.

Tulare: Tulare Astronomical Association, P.O. Box 515, 93275, George B. Thrasher, (209) 686-5669, 85 members, observatory, 10" scope. Hotline: 685-0585.

Upland: Pomona Valley Amateur Astronomers, P.O. Box 162, 91786, Harvard Pennington, (714) 983-7308.

Van Nuys: Los Angeles Valley College Astronomy Club, 5800 Fulton Ave., 91401, Bruce Dale, (818) 781-1200.

Waterford: Stanislaus Amateur Astronomers, 12129 Washburn Ave., 95386, Howard Wilson, (209) 874-4313, observatory, 14" scope.

Whittier: Western Observatory, 14517 E. Broadway, 90604, Roger Wilcox, (213) 941-9755.

Woodland Hills: Polaris Astronomical Association, 22018 Ybarra Rd., 91364, Ray Coutchie, (818) 347-8922, 30 members, open to the public, 12" scope.

Yucca Valley: Andromeda Astronomical Society, 56089 29 Palms Hwy., Suite 455, 92284, Bill Crawford, 20 members.

PLACES

Apple Valley: Apple Valley Science and Technology Center, 15552 Wichita Rd., 92309, (619) 242-4115.

Aptos: Cabrillo College Planetarium, 6500 Soquel Dr., 95003, (408) 479-6506, 21" dome theater, observatory, 14" scope. Open by reservation.

Berkeley: Lawrence Hall of Science, Astronomy and Physics Education, University of California, 94720, (510) 642-5362, 25' dome theater, observatory, reflector. Open daily except major holidays. Program info: 642-5133.

Big Bear City: Big Bear Solar Observatory, 40386 North Shore Ln., 92314, (714) 866-5791, tours.

Cassel: Hat Creek Radio Observatory, Univ. of California, Berkeley, Rt. 2, Box 500, 96013, (916) 335-2364, observatory, 20" scope, tours. Open Mon.-Fri., by reservation.

Chula Vista: Southwestern College Planetarium, 900 Otay Lakes Rd., 91910, (714) 421-6700, 30' dome theater, observatory, 12" scope.

Cupertino: Minolta Planetarium, DeAnza College, 21250 Stevens Creek Blvd., 95014, (408) 864-8282, 50' dome theater, exhibits. Program info: 864-8814.

Edwards: NASA Dryden Flight Research Facility, P.O. Box 273, M/S 2149 Research Library, 93523,

(805) 258-3702, tours. Open daily, except Christmas and New Years Day. Program info: 258-3460.

Eureka: College of the Redwoods Planetarium, Tompkins Hill Rd., 95501, (707) 445-6831, 14' dome theater, observatory, 14" scope.

Fresno: Discovery Center, 1944 North Winery Ave., 93703, (209) 255-5533, exhibits, tours.

Hayward: Chabot College Planetarium, 25555 Hesperian Blvd., 94545, (510) 786-6881, 30' dome theater, observatory, planetarium.

Kelseyville: Taylor Observatory and Planetarium, 5725 Oak Hill Ln., 95451, (707) 279-8372, 20' dome theater, observatory, 12.5" scope.

Lompoc: Western Spaceport Museum Observatory, Ken Adam Park, 93436, (805) 736-6381, observatory, 14" scope.

Los Angeles: California Museum of Science & Industry, Exposition Park, 700 State Dr., 90037, (213) 744-7483.

Los Angeles: Griffith Observatory, 2800 East Observatory Rd., 90027, (213) 664-1181, 75' dome theater, observatory, 12" refractor, exhibits. Open Tues.-Sun. Program info: 664-1191.

Los Angeles: University of California-Los Angeles, U.C.L.A. Dept. of Astronomy, 405 Hilgard Ave., 90024-1562, (213) 825-4434.

Moffett Field: NASA Ames Research Center, Mail Stop 20-27, 94035, (415) 604-6497.

Mount Hamilton: Lick Observatory, P.O. Box 85, 95140, (408) 274-5062, observatory, 40" scope. Program info: 274-5061.

Mountain View: Foothill College Observatory, c/o Peninsula Astronomical Society, P.O. Box 4542, 94040, (408) 286-4997, observatory, 16" Newtonian. Open clear Fri. Program info: (415) 949-7334.

Oakland: Chabot Observatory and Planetarium, 4917 Mountain Blvd., 94619, (415) 531-4560, 30' dome theater, observatory, 20" scope.

Owens Valley: Owens Valley Radio Observatory, Robinson Laboratory, California Institute of Technology, Pasadena, 91125, (818) 356-4912.

Pasadena: Mount Wilson Institute, 740 Holladay Rd., 91106, observatory, 24" scope, exhibits, tours. Open weekends only. Program info: (818) 793-3100.

Pasadena: NASA Jet Propulsion Laboratory, 4800 Oak Grove, 91109, (818) 354-8593.

Pasadena: Palomar Observatory, California Institute of Technology, 91125, (619) 742-2119, observatory, 200" scope.

Pittsburg: Los Medanos College Planetarium, 2700 E. Leland Rd., 94565, (510) 439-2181.

Pleasant Hill: Diablo Valley College Planetarium, 321 Golf Club Rd., 94523, 24' dome theater, observatory, SCT. Program info: (510) 685-1230 x423.

Redding: Schreder Planetarium, Shasta County Office of Education, 1644 Magnolia Ave., 96001-1599, (916) 225-0275, 33' dome theater, observatory, planetarium. Open Tues.-Thurs. for school groups. Program info: 225-0251.

Rocklin: Sierra College Planetarium, 500 Rocklin Rd., 95677, (916) 624-3333.

Rohnert Park: Sonoma State University Observatory, Dept. of Physics and Astronomy, 94928, (707) 664-2119, observatory, 14" reflector.

Sacramento: Sacramento Science Center, 3615 Auburn Blvd., 95821, (916) 277-6181, 30' dome theater, observatory, exhibits. Open Wed.-Sun. Program info: 485-8836.

Salinas: J. Frederick Ching Planetarium, Hartnell College, 156 Homestead Ave., 93901, (408) 755-6800.

San Bernardino: San Bernardino Valley College Planetarium, 701 South Mt. Vernon Ave., 92410-1458, 33' dome theater, observatory, 16" reflector. Program info: (909) 888-6511 x1458.

San Diego: Mount Laguna Observatory, Astronomy Department, San Diego State University, 92182, (619) 594-6182, 20' dome theater, observatory, 21" reflector. Open by reservation.

San Diego: Reuben H. Fleet Space Theater and Science Center, 1875 El Prado, Balboa Park, 92101, (619) 238-1233, 76' dome theater, observatory.

San Diego: San Diego Aerospace Museum, 2001 Pan American Plaza, 92101, exhibits, tours. Program info: (619) 234-8291.

San Francisco: City College of San Francisco Planetarium, 50 Phelan Ave., 94112, (415) 239-3242.

San Francisco: Exploratorium, 3601 Lyon St., 94123, (415) 563-7337, exhibits. Open Tues.-Sun. Program info: 561-0360.

San Francisco: Morrison Planetarium, California Academy of Sciences, Golden Gate Park, 94118, (415) 750-7127, 65' dome theater, observatory. Program info: 750-7141.

San Francisco: San Francisco State University, Dept. of Astronomy and Physics, 1600 Holloway Ave., 94132, (415) 338-1859, 27' dome theater, observatory, 16" reflector.

San Jose: Independence Planetarium, 1776 Educational Park Dr., 95133, (408) 729-3911.

San Jose: Rosicrucian Planetarium, Rosicrucian Park, 1342 Nagler Ave., 95191-0001, Steve Parker, (408) 947-3640, 40' dome theater. Program info: (408) 947-3636.

San Luis Obispo: San Luis Obispo High School Planetarium, 1350 San Luis Dr., 93401, (805) 544-5770.

San Marcos: Palomar College Planetarium, 1140 W. Mission Rd., 92069-1487, 30' dome theater, observatory, 14" SCT, exhibits. Open by reservation. Program info: (619) 744-1150 ext 2833.

San Mateo: College of San Mateo Planetarium, 1700 W. Hillsdale Rd., 94402, (415) 574-6256.

San Pablo: Contra Costa College Planetarium, 2600 Mission Bell Dr., 94806, (415) 235-7800.

Santa Barbara: Gladwin Planetarium/Palmer Observatory, 2559 Puesta del Sol Rd., 93105, (805) 682-4711 ext 326, 24' dome theater, observatory, 29" reflector, exhibits, tours. Open weekends for the public; weekdays for school groups. Program info: 682-3224.

Santa Monica: Santa Monica College Planetarium, 1900 Pico Blvd., 90405, (310) 452-9223, 24' dome theater, observatory, 10" SCT.

Santa Rosa: Santa Rosa Junior College Planetarium, 1501 Mendocino Ave., 95401, (707) 527-4640, 40' dome theater, exhibits. Program info: 527-4465.

Saratoga: West Valley College Planetarium, 14000 Fruitvale Ave., 95018, (408) 741-2044, 30' dome theater.

Stockton: Clever Planetarium and Earth Science Center, San Joaquin Delta College, 5151 Pacific Ave., 95207, (209) 474-5051, 33' dome theater, observatory, Cinema 360°, exhibits, tours. Open daily by reservation. Program info: 474-5110.

Walnut: Mt. San Antonio College Planetarium, 1100 North Grand Ave., 91789, (714) 594-5611, 35' dome theater, observatory, 14" scope.

Weed: College of the Siskiyous Observatory, 800 College Ave., 96094, (916) 938-4463.

Whittier: Rio Hondo College, 3600 Workman Mill Rd., 90608, (310) 692-0921, observatory, 14" reflector.

COLORADO

CLUBS

Colorado Springs: Colorado Springs Astronomical Society, P.O. Box 62022, 80962, Steve Bygren, (719) 599-3612, 48 members, open to the public, 16" scope.

Colorado Springs: Rocky Mountain Astrophysical Group, 12815 Porcupine Ln., 80908, Paul Van Slyke, (719) 495-3828, 100 members, observatory, 30" scope.

Denver: Denver Astronomical Society, c/o Chamberlain Observatory, 2930 E. Warren Ave., 80210, Dave Trott, (303) 871-5172, observatory, 20" scope.

Elbert: High Plains Astronomy Club, 13265 Bozeman Trail, 80106, Mike Silva, (719) 495-0873, observatory, 11" scope.

Grand Junction: Western Colorado Astronomy Club, P.O. Box 55032, 81505, Harry Brauneis, (303) 285-9553, 31 members.

Longmont: Longmont Astronomical Society, P.O. Box 8029, 80501, Bob Noble, (303) 772-7595, 50 members.

Pueblo: Southern Colorado Astronomical Association, 2801 8th Ave., 81003, Mike Bosley.

PLACES

Alamosa: Harry Zacheis Planetarium and Observatory, Adams State College, 81102, (719) 589-7616, 13' dome theater, observatory, 17.5" reflector. Open by reservation.

Boulder: Fiske Planetarium, University of Colorado, Campus Box 408, 80309-0408, (303) 492-5002, 68' dome theater, observatory, 24" reflector. Open by reservation. Program info: 492-5001.

Boulder: National Center for Atmospheric Research (NCAR), 1850 Table Mesa Dr., 80303, (303) 497-1173, exhibits, tours. Program info: 497-1174.

Colorado Springs: Black Forest Observatory, 12815 Porcupine Ln., 80908, observatory, 30" SCT. Open by reservation. Program info: (719) 495-3828.

Colorado Springs: U.S. Air Force Academy Planetarium, Center for Educational Multimedia, U.S. Air Force Academy, 80840, (719) 472-2779, 50' dome theater, observatory. Program info: 472-2778.

Denver: Chamberlin Observatory, University of Denver, Dept. of Physics, 80208, observatory, 20" refractor, tours. Program info: (303) 871-2238.

Denver: Gates Planetarium, Denver Museum of Natural History, 2001 Colorado Blvd., 80205, (303) 370-6317, 50' dome theater, observatory, 22" SCT, IMAX, exhibits. Program info: 370-6351.

CONNECTICUT

CLUBS

New Haven: Astronomical Society of New Haven, P.O. Box 3005, 06515, Al Washburn or Linda Marks, (203) 874-4816, 75 members, observatory, 10" scope.

Oakdale: Thames Astronomical Society, 55 Doyle Rd., 06370, Kathleen Audette, (203) 859-0071.

Stamford: Fairfield County Astronomical Society, Stamford Museum Observatory, 39 Scofieldtown Rd., 06903, Charles E. Scovil, (203) 322-1648, 45 members, observatory, 22" scope.

Stratford: Boothe Memorial Astronomical Society, 114 King's College Place, 06497, Vincent Manjoney, (203) 375-9673, 20 members, observatory, 16" scope.

Torrington: Litchfield Hills Amateur Astronomy Club, 361 Funston Ave., 06790, David H. Wheeler, (203) 489-8898, 30 members.

Waterbury: Mattatuck Astronomical Society, Mattatuck Community College, 750 Chase Parkway, 06708, J. Lawrence Pond, (203) 575-8236, observatory, 14" scope.

West Hartford: Astronomical Society of Greater Hartford, Gengras Planetarium, 950 Trout Brook Dr., 06119, Jay Sottolano, (203) 651-0096.

Westport: Westport Astronomical Society, P.O. Box 5118, 06881-5118, Bob Deedan, (203) 226-8812, observatory, 12.5" scope.

PLACES

Avon: Talcott Mountain Science Center, Montevideo Rd., 06001, 44' dome theater, observatory, 17" scope. Open by reservation. Program info: (203) 677-8571.

Danbury: Western Connecticut State University Observatory & Planetarium, 181 White St., 06810, 26' dome theater, observatory, 20" reflector, planetarium. Program info: (203) 797-4215.

Middletown: Van Vleck Observatory, Wesleyan University, 06419, (203) 347-9411 x2825, observatory, 24" scope, exhibits, tours. Open by reservation.

Mystic: Mystic Seaport Museum & Planetarium, P.O. Box 6000, Greenmanville Ave., 06355, (203) 572-0711, 30' dome theater, observatory.

New Britain: Copernican Observatory and Planetarium, Central Connecticut State University, Wells St., 06050, (203) 827-7852.

New Haven: Southern Conn. State University Planetarium, Fitch and Pine Rock Streets, 06515, (203) 397-4351, 24' dome theater, observatory, 12" scope.

Stamford: Stamford Museum & Nature Center, 39 Scofieldtown Rd., 06903, (203) 322-1646, 23' dome theater, observatory, 22" Maksutov, exhibits, tours. Open daily, except for Christmas and New Year's.

Storrs: University of Connecticut Planetarium, Physics Department U-46, 2152 Hillside Rd., 06269, (203) 486-4915, 16' dome theater, observatory, 6" refractor, tours. Open by reservation.

West Hartford: Gengras Planetarium, Science Museum of Connecticut, 950 Trout Brook Dr., 06119, (203) 236-2961.

Willimantic: Robert K. Wickware Planetarium, Eastern Conn. State University, 83 Windham St., 06226, 30' dome theater, exhibits. Open by reservation. Program info: (203) 456-5300.

DELAWARE

CLUBS

Wilmington: Delaware Astronomical Society, P.O. Box 652, 19899, Henry Bouchelle, (302) 655-3230, 150 members, 12" scope.

Greenville: Mt. Cuba Astronomical Observatory Inc., P.O. Box 3915, Hillside Mill Rd., 19807, observatory, 24" scope.

DISTRICT OF COLUMBIA

PLACES

Washington: Albert Einstein Planetarium, National Air and Space Museum, 6th Street and Independence Ave SW, 20560, (202) 357-1529, 70' dome theater, IMAX. Program info: 357-1550.

Washington: Rock Creek Nature Center, 5200 Glover Rd., NW, 20015, (202) 426-6829, 24' dome theater. Open Wed.-Sun.

Washington: U.S. Naval Observatory, 34th and Massachusetts Avenue NW, 20392, (202) 653-1543, observatory, 26" scope.

FLORIDA

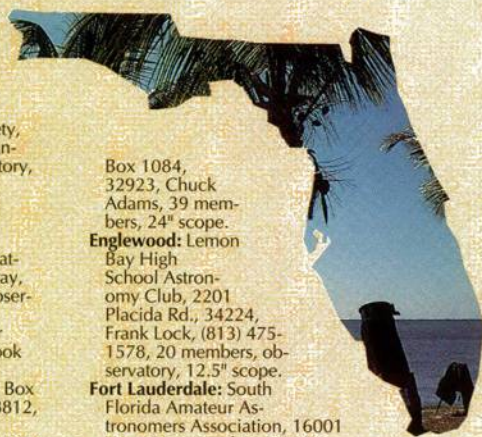
CLUBS

Altamonte Springs: Central Florida Astronomical Society, P.O. Box 161590, 32716-1590, Bob Pickman, (407) 679-7447, 130 members.

Bradenton: Local Group of Deep-Sky Observers, 2311 23rd Avenue West, 34205, Vic and Lynne Menard, (813) 747-8334, 95 members.

Callahan: Callahan Astronomical Society, Route 3, Box 1062, 32011.

Cocoa: Brevard Astronomical Society, P.O.



Box 1084, 32923, Chuck Adams, 39 members, 24" scope.

Englewood: Lemon Bay High School Astronomy Club, 2201 Placida Rd., 34224, Frank Lock, (813) 475-1578, 20 members, observatory, 12.5" scope.

Fort Lauderdale: South Florida Amateur Astronomers Association, 16001 West State Road 84, 33326, David Goldstein, (305) 966-7904, 85 members, observatory, 14" scope.

Fort Myers: Southwest Florida Astronomical Society, P.O. Box 6583, Miracle Mile Station, 33911-6583, Alan Goldman, (813) 495-2000.

Fort Pierce: Treasure Coast Astronomical Society, 131 Queen Catherine Ct., 34949, Walter Swentzell, Hotline: (407) 465-4454.

Gainesville: Alachua Astronomy Club, P.O. Box 12247, University Station, 32604-0247, Jeff Majewski, (904) 475-1014, 37 members.

Jacksonville: North East Florida Astronomical Society (NEFAS), P.O. Box 16574, 32245-6574, Stephen Meeks, (904) 731-0086, 75 members, observatory, 14.5" scope.

Largo: Tampa Area Astronomy Society, 9890 82nd Street N., 34647, John Novak, (813) 392-4699, observatory, 20" scope.

Melbourne: Indian River Astronomical Society, 1201 Sunnypoint Dr., 32935.

Melbourne: Society for Astronomy and Space Sciences, Florida Institute of Technology, 32901-6988, Michael Adams, (407) 768-8000, observatory with 14" scope.

Miami: Belen Jesuit Prep School Astronomy Club, 500 SW 127th Ave., 33184, Leo Nunez, (305) 223-8600, observatory, 8" scope.

Miami: Southern Cross Astronomical Society, 13841 SW 106 St., 33186, Robert Ward, (305) 385-5021, 160 members, observatory, 14" scope. Hotline: 661-1375.

Naples: Everglades Astronomical Society, 780-C Meadowland Dr., 33963, Peter Wlasuk, (813) 597-5088, 50 members.

Palm Beach Gardens: Astronomical Society of the Palm Beaches, P.O. Box 30023, 33420, Elizabeth Long, (407) 746-8064, 80 members.

Panama City: Astronomical Society of Bay County, 1021 Oxford Dr., 32405-3427, Glen Deason, (904) 783-5861, 37 members.

Pensacola: Escambia Amateur Astronomers, 6235 Omie Circle, 32504-7625, Dr. J. Wayne Wooten, (904) 477-8859, 160 members, open to the public, 16" scope.

St. Augustine: Ancient City Astronomy Club, P.O. Box 546, 32085-0546, A. L. Ponjee, (904) 797-5704, 25 members, 12.5" scope.

St. Petersburg: St. Petersburg Astronomy Club Inc., 594 59th Street South, 33707, Daniel W. Bricker, (813) 343-1594, 140 members, observatory, 14.5" scope.

Sebring: Highlands Stargazers, 2130 Gresham St., 33872, Richard Lindblom, (813) 655-0131, 15 members.

Seminole: Astro Scopers, 8350 81st North, 34647, Joanne Klein, (813) 397-4235, 20 members, observatory, 14" scope.

Tallahassee: Tallahassee Astronomical Society, 975 Richardson Rd., 32301, Joseph Haley, (904) 386-1874, 35 members, observatory, 14" scope.

Tampa: Museum Astronomical Resource Society (MARS), 2602 E. 98th Ave., 33612, Craig MacDougal, (813) 933-9617, 30 members.

PLACES

Bradenton: Bishop Planetarium, 201 10th St. W., 34205, (813) 746-4132, 50' dome theater, observatory, 6" refractor, exhibits, tours. Open Tues.-Sun. Program info: 746-STAR.

Cape Canaveral: U.S. Air Force Space Museum, Cape Canaveral Air Force Station, 32925, (407) 853-3245.

Cocoa: Astronaut Memorial Space Science Center, Brevard Community College, 1519 Clearlake Rd., 32922, (407) 631-7889, 40' dome theater, observatory, 24" SCT. Program info: 632-1111 x3500.

Davie: Buehler Planetarium, 3501 SW Davie Rd., 33314, (305) 475-6681, 40' dome theater, observatory, 10" SCT. Program info: 475-6680.

Daytona Beach: Museum of Arts and Sciences Planetarium, 1040 Museum Blvd., 32114, 40' dome theater, observatory. Open Tues.-Sun. Program info: (904) 255-0285.

Fort Myers: Calusa Nature Center and Planetarium, 3450 Ortiz Ave., P.O. Box 60023, 33906, (813) 275-3435, 40' dome theater, observatory, 4" scope, Cinema 360°. Open Thurs.-Sun. Program info: 275-3183.

Gainesville: University of Florida Observatory, P.O. Box 112055, 32611, (904) 392-7799, observatory, 12" reflector, tours, exhibits. Open Fri. evenings during school year.

Jacksonville: Alexander Brest Planetarium, Jacksonville Museum of Sciences and History, 1025 Museum Circle, 32207-9053, 60' dome theater, observatory, exhibits, tours. Program info: (904) 396-7061 x4.

Kennedy Space Center: Kennedy Space Center Spaceport USA, Mail Code TWRS, 32899, (407) 452-2121.

Lehigh: Milky Way Recreational Telescopes, 24 Massachusetts Rd., 33936-6746, observatory, 17.5" reflector. Open by reservation. Program info: (813) 368-6106.

Melbourne: Space Coast Science Center, 1510 Highland Ave., P.O. Box 36-1816, 32936, (407) 259-5572.

Miami: Miami Space Transit Planetarium, 3280 South Miami Ave., 33129, 65' dome theater, observatory, 17" reflector, exhibits. Program info: (305) 854-2222.

North Palm Beach: Aldrin Planetarium & Gibson Observatory, 4801 Dreher Trail North, 33405, (407) 832-1988, 30' dome theater, observatory, 11" SCT, exhibits.

Orlando: John Young Planetarium, 810 East Rollins St., 32803, 40' dome theater, observatory, 14" scope, exhibits. Program info: (407) 896-7151.

Pensacola: Owens Planetarium, Pensacola Junior College, 1000 College Blvd., 32504, (904) 484-2516, 30' dome theater, exhibits. Program info: 484-1150.

St. Augustine: Fountain of Youth Planetarium, 155 Magnolia Ave., 32084, (904) 829-6138, 30' dome theater, observatory.

St. Petersburg: Science Center of Pinellas Co. Planetarium, 7701 22nd Avenue North, 33710, (813) 384-0027, 16' dome theater, observatory.

St. Petersburg: St. Petersburg Junior College Planetarium, 5th Ave. North at 69th St., 33710, (813) 341-4320, 24' dome theater, observatory, SCT.

Tallahassee: Observatory, Dept. of Physics, Florida A&M University, observatory, 14" SCT.

Tallahassee: Pat Thomas Planetarium, Florida State University, Dept. of Physics B-159, 32306, (904) 644-6822, 30' dome theater, observatory. Program info: 644-2098.

Titusville: U. S. Astronaut Hall of Fame, Kennedy Space Center, 32780, (407) 269-6100.

GEORGIA

CLUBS

Athens: Athens Astronomical Association, 160 Plantation Dr., 30605, Maurice E. Snook, (706) 543-3753, 5 members.

Atlanta: Astronomical Society of the Atlantic, P.O. Box 15038, 30333, Ingrid Tanghe, (404) 873-1453, 200 members, observatory, 30" scope. Hotline: 264-0451.

Atlanta: Atlanta Astronomy Club, P.O. Box 29631, 30359-0631, Bud Rosser, (404) 873-0304, 140 members, observatory, 20" scope. Hotline: 621-2661.

Augusta: Astronomy Club of Augusta, P.O. Box 6373, 30916, Jim Cadieux, (803) 649-5672, 50 members.

Columbus: Chattahoochee Valley Astronomical Society, c/o Patterson Planetarium, 2900 Woodruff Farm Rd., 31907, Clay Powers, (706) 569-2549, 25 members.

Macon: Middle Georgia Astronomical Society, Museum of Arts and Sciences, 4182 Forsyth Rd., 31210, Gary L. Kretsinger, (912) 956-2145.

Savannah: Oglethorpe Astronomical Association, c/o Savannah Science Museum, 4405 Paulsen St., 31405, Vickie Watson, 25 members.

PLACES

Albany: Wetherbee Planetarium, 100 Roosevelt Ave., 31701, (912) 435-1572, 20' dome theater, observatory, exhibits. Program info: 435-1572.

Atlanta: Fernbank Science Center, 156 Heaton Park Drive NE, 30307, (404) 378-4311 x 831, 70' dome theater, observatory, 36" SCT, IMAX.

Columbus: Patterson Planetarium, 2900 Woodruff Farm Rd., 31907, (404) 568-1730, 40' dome theater, observatory. Program info: 568-1730.

Dahlonega: North Georgia College, Coleman Planetarium, Physics Department, 30597, (404) 864-1511, 30' dome theater, observatory, 16" SCT. Program info: 864-1470.

Decatur: Agnes Scott College, Bradley Observatory, 141 E. College Ave., 30030-3797, (404) 371-6265, 12' dome theater, observatory, 14" SCT, tours. Open daily during school year by reservation. Program info: 371-6266.

Fairmount: Sunrise Planetarium and Science Museum, Camp Sunrise, 1427 Slate Mine Road SE, 30139-2835, (706) 337-2776, 35' dome theater, observatory.

Macon: Mark Smith Planetarium, Museum of Arts and Sciences, 4182 Forsyth Rd., 31210-4806, (912) 477-3232, 40' dome theater, observatory, 14" SCT, exhibits, tours.

Rock Spring: Walker County Science Center, P.O. Box 10, Highway 95, 30739, 24' dome theater, tours. Program info: (404) 764-1111.

Savannah: Savannah Science Museum, 4405 Paulsen St., 31405, 24' dome theater, exhibits. Open Tues.-Sun. Program info: (912) 355-6705.

Statesboro: Georgia Southern University Planetarium, Landrum Box 8031, 30460, 30' dome theater, exhibits, tours. Open by reservation. Program info: (912) 681-5292.

Valdosta: Valdosta State College Planetarium, Dept. of Physics, Astronomy and Geology, 31698, (912) 333-5752, 24' dome theater, observatory, 16" SCT. Program info: 333-5980.

Young Harris: Rollins Planetarium, Young Harris College, 30582, (706) 379-3111, 40' dome theater, observatory. Open Mon.-Fri. Program info: 379-3990.

HAWAII

CLUBS

Hilo: Mauna Kea Astronomical Society, 175 Banyan Dr., #217, 96720, Bruce Marten, (808) 969-7357, 15 members, 17.5" scope.

Honolulu: Hawaiian Astronomical Society, P.O. Box 17671, 96817, Ray Fabre, (808) 486-3141, 200 members, observatory, 12.5" scope.

Puunene: Maui Astronomy Club, P.O. Box 1168, 96784, Daniel O'Connell, (808) 878-3172.

Waimea: Kauai Educational Association for Science & Astronomy, P.O. Box 161, 96796, Carmelita Miranda, (808) 337-9422, 30 members, observatory, 14" scope. Hotline: 245-8250.

PLACES

Hilo: Mauna Kea Observatories Support Services, 177 Makaala St., 96720, (808) 935-3371, observatory, 11" SCT, exhibits, tours. Open Fri.-Sun. Program info: 961-2180.

Honolulu: Bishop Museum and Planetarium, 1525 Bernice St., P.O. Box 19000-A, 96817, (808) 848-4102, 30' dome theater, observatory, 12" scope. Program info: 848-4136.

Honolulu: Mauna Kea Observatories, Institute for Astronomy, 2680 Woodlawn Dr., 96822, (808) 948-8312.

Kamuela: Canada-France-Hawaii Telescope, Mauna Kea, P.O. Box 1597, 96743, (808) 885-7944.

IDAHO

CLUBS

Boise: Boise Astronomical Society, P.O. Box 8386, 83707, Richard Beaver, (208) 377-5220, 82 members. Hotline: 338-7775.

Idaho Falls: Idaho Falls Astronomical Society, 1710 Claremont Ln., 83404, Jim Ruggiero, (208) 524-6317, 15 members.

Pocatello: Pocatello Astronomical Society, 100 Ranch Dr., 83204, Timothy F. Cole, (208) 233-2638, 10 members.

PLACES

Caldwell: Whettenberger Planetarium, College of Idaho, 2112 Cleveland, 83605, (208) 459-5011. Program info: 495-2125.

ILLINOIS

CLUBS

Batavia: Fox Valley Astronomical Society, P.O. Box 508, 60510, Richard Klappal, (708) 844-2120, 35 members, observatory, 16" scope.

Champaign: Champaign-Urbana Astronomical Society, c/o Champaign Park District, 706 S. Kenwood Rd., 61821, Mike Rosenberger, (217) 359-664, 75 members, observatory, 16" scope.

Chicago: Chicago Astronomical Society, P.O. Box 30287, 60630-0287, Michael F. Barrett, 135 members. Hotline: (312) 725-5618.

Glenview: Skokie Valley Astronomers, 910 Glenwood Ln., 60025, Gretchen Trinklein, (708) 998-1627, 24 members.

Jacksonville: Central Illinois Astronomical Association, Illinois College, 62650, Frederick Pilcher, (217) 245-3412, observatory, 14" scope.

Libertyville: Lake County Astronomical Society, 603 Daves St., 60048, Jack Kramer, (708) 362-0959, 60 members.

Lisle: Illinois Benedictine College Astronomical Society, 5700 College Rd., 60532, Rev. Robert S. Buday, O.S.B., (708) 969-6410, 10 members, observatory, 16.5" scope.

Montgomery: Amateur Astronomers of Aurora, 69 Sheffield, 60538.

Mount Olive: Mount Olive Astronomical Society, 412 West 4th Street South, 62069.

Naperville: Naperville Astronomical Association, 921 Woodcrest Ln., 60439, John Lehuta, (708) 257-0508, 80 members, observatory, 10" scope.

Normal: Twin City Amateur Astronomers, P.O. Box 755, 61761-0755, Michael E. Miller, (309) 452-4298, 80 members, observatory, 14" scope. Hotline: 438-5007.

Palatine: Northwest Suburban Astronomers, 1550 Alison Dr., 60067, Gary Poliquin, (708) 358-7594, 120 members.

Palos Hills: Astronomical Association of the University of Illinois, 8850 W. 101st Place, 60465, Suresh K. Sreenivasan, (708) 599-2458.

Peoria: Peoria Astronomical Society, 1125 West Lake Ave., 61614, Mike Frasca, 95 members, observatory, 24" scope.

Quincy: Quincy Astronomical Society, 3001 Lantern Ln., 62301, Kent R. Haroz, (217) 224-4733, 22 members, observatory, 16" scope.

Rock Island: Popular Astronomy Club, John Deere Planetarium, Augustana College, 61201, Paul R. Castle, (309) 786-6119, 61 members.

Rockford: Rockford Amateur Astronomers Inc., 6804 Alvina Rd., 61101, Barry Beaman, (815) 962-6540, 51 members, observatory, 10" scope. Hotline: 964-6457.

St. Charles: Argonne Astronomy Club, 6N106 White Oak Ln., 60175, H.F. DaBoll, (312) 584-1162.

Springfield: Springfield Astronomy Society, 2224 S. 13th St., 62703, Don Walker.

PLACES

Bloomington: Observatory, Illinois Wesleyan University, 61702, (309) 556-3060, observatory, 16" SCT.

Champaign: William M. Staerkel Planetarium, Parkland College, 2400 W. Bradley Ave., 61821-1899, (217) 351-2568, 50' dome theater,



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observatory, 8" SCT, Cinema 360°. Open Mon.-Sat. Program info: 351-2446.

Chicago: Adler Planetarium, 1300 South Lake Shore Dr., 60605, (312) 322-0337, 68" dome theater, observatory, 20" scope, exhibits. Program info: 922-STAR.

Chicago: Museum of Science & Industry and Crown Space Center, 57th Street and Lake Shore Dr., 60637, OMNIMAX, exhibits. Program info: (312) 684-1414.

Evanson: Dearborn Observatory, Northwestern University, 2131 Sheridan Rd., 60201, (708) 491-7650, observatory, 18" scope.

Joliet: Herbert Trackman Planetarium, Joliet Junior College, 1216 Houbolt Ave., 60436, (815) 729-9020 ext. 2115, 30" dome theater.

Kankakee: Strickler Planetarium, Olivet Nazarene University, P.O. Box 592, 60901-0592, 30" dome theater, observatory, 8" SCT, exhibits, tours. Open by reservation. Program info: (815) 939-5395.

Normal: Illinois State University Planetarium, 61790-4560, (309) 438-8756, 30" dome theater. Open by reservation. Program info: 438-2496.

Peoria: Lakeview Museum of Arts and Sciences, 1125 West Lake Ave., 61614, (309) 686-7000, 33" dome theater, exhibits. Program info: 686-NOVA.

River Grove: Cernan Earth & Space Center, Triton College, 2000 Fifth Ave., 60171, (312) 456-0300 x 372, 44" dome theater, Cinema 360°, exhibits. Open Mon.-Sat. Program info: 456-5815.

Rockford: Discovery Center Museum, 711 North Main St., 61103-6903, (815) 963-6769, 20" dome theater, exhibits, tours. Open Tues.-Sat. during school year.

Rockford: Time Museum, 7801 East State St., I-90 and Business 20, 61108, (815) 398-6000, x 2493, exhibits, tours. Open Tues.-Sun.

Urbana: University of Illinois Observatory, 103 Astronomy Building, 1002 W. Green St., 61801-3547, observatory, 12" refractor.

INDIANA

CLUBS

Evansville: Evansville Astronomical Society, P.O. Box 3474, 47733, Scott Conner or Charles Miller, (812) 428-3970, 59 members, observatory, 14" scope.

Griffith: Calumet Astronomical Society, 940 North Broad St., 46319, Stephen J. Miller, 100 members, observatory, 16" scope. Hotline: (219) 845-9174.

Mooreville: Indiana Astronomical Society, Two Wilson Dr., 46158, J. Philip May, (317) 831-8387, 160 members, observatory, 36" scope. Hotline: 831-0668.

South Bend: Michiana Astronomical Society, P.O. Box 262, 46624-0262, Thomas Nowicki, (219) 255-9492, 35 members.

West Lafayette: Wabash Valley Astronomical Society, 2367 Yeager Road #102, 47906, William Annis, (317) 463-3741, observatory, 14" scope.

Winona Lake: Warsaw Astronomical Society, 1308 Sunset Dr., 46590, Kurt Eberhardt or Jim Tague, (219) 269-1856, 30 members, observatory, 12.5" scope.

PLACES

Bloomington: Kirkwood Observatory, Indiana University, 47401, (812) 855-6911, observatory, 12" scope.

Evansville: Koch Science Center and Planetarium, 411 SE Riverside Dr., 47713, (812) 425-2406, 30" dome theater, exhibits, tours. Open Tues.-Sun., except for July 4 and Labor Day.

Evansville: Wahnsiedler Observatory, P.O. Box 3474, 47733, (812) 922-5681, observatory, 14" scope.

Fort Wayne: E. C. Schouweiler Planetarium, Saint Francis College, 2701 Spring St., 46806, (219) 434-3278, 35" dome theater, observatory.

Greencastle: McKim Observatory, DePauw University, Dept. of Physics and Astronomy, 46135, (317) 658-4654, observatory, 9.5" refractor. Program info: 658-4661.

Indianapolis: Holcomb Observatory & Planetarium, Butler University, 4600 Sunset Ave., 46208, (317) 283-9282, 24" dome theater, observatory, 38" SCT, tours, exhibits. Open weekends. Program info: 283-9333.

Indianapolis: Spacequest Planetarium, Children's Museum of Indianapolis, 3000 North Meridian St., 46208, (317) 924-5431, 40" dome theater, observatory. Program info: 921-4014.

Marshall: Turkey Run State Park Nature Center, Route 1, Box 164, 47859-9764, (317) 597-2635, 16" dome theater, observatory. Open Tues. and Wed., Dec.-Mar. Program info: 597-2654.

Merrillville: Merrillville Community Planetarium, Clifford Pierce Middle School, 199 East 70th Ave., 46410, 30" dome theater, observatory, 8" scope, planetarium. Open for scheduled public

shows and by reservation. Program info: (219) 736-4856.

Muncie: Ball State University Planetarium, 47306, (317) 285-8871, 30" dome theater, observatory, 14" SCT. Open by reservation.

North Manchester: Charles S. Morris Observatory, Manchester College, 46962, (219) 982-5311, observatory, 10" reflector. Program info: 982-6021.

Terre Haute: John C. Hook Memorial Observatory, Indiana State University, 47802, observatory, 10" SCT, tours. Program info: (812) 237-2444.

Vincennes: Dunseth Planetarium, Vincennes University Community College, 47591, (812) 885-4229, 40" dome theater, observatory. Program info: 882-5486.

IOWA

CLUBS

Ames: Ames Area Amateur Astronomers, 1009 16th St., 50010, Jack Troeger, (515) 232-2317, 85 members, observatory, 12.5" scope.

Burlington: Southeastern Iowa Astronomy Club, 610 Walnut St., 52601-5902, Jim Blair, (319) 753-2509, 85 members, observatory, 12" scope. Hotline: 985-2163.

Davenport: Quad Cities Astronomical Society, P.O. Box 3706, 52808, William Brown, (319) 786-9622, observatory, 20" scope.

Des Moines: Des Moines Astronomical Society, Inc., c/o C. L. Allen, 2307 49th St., 50310-2538, C. L. Allen, 37 members, observatory, 16" scope.

Iowa City: Iowa City Amateur Astronomers, 2014 Hollywood Blvd., 52240, Dick Fesenmeyer, (319) 351-8250.

Iowa City: Iowa City Astronomy Club, P.O. Box 325, 52244, James Mulherin, (319) 339-0524, 90 members.

Marion: Cedar Amateur Astronomers, 701 Heather Ct., 52302, John Centala, (319) 377-0125, 38 members, observatory, 12.5" scope.

Waterloo: Cedar Valley Amateur Astronomers Association,

503 South St., 50701, Aaron Spurr, (319) 266-4015, 25 members.

PLACES

Bettendorf: Donald A. Schaefer Planetarium, Bettendorf High School, 3333 18th St., 52722, (319) 332-7001, 33" dome theater.

Cedar Falls: Hillside Observatory, University of Northern Iowa, Dept. of Earth Sciences, 50614, (319) 273-2389, observatory, 16" reflector.

Cherokee: Sanford Museum and Planetarium, 117 East Willow St., 51012, 18" dome theater, observatory. Program info: (712) 225-3922.

Decorah: Luther College Planetarium, Physics Department, 700 College Dr., 52101, (319) 387-1712, 20" dome theater, observatory. Program info: 387-1117.

Des Moines: Drake University Observatory, Drake University, 50311, (515) 271-3141.

Des Moines: Science Center of Iowa, 4500 Grand Ave., 50312, (515) 274-6868, 40" dome theater, exhibits. Open daily, except Thanksgiving and Christmas. Program info: 274-4138.

Dubuque: Heitkamp Memorial Planetarium, Loras College, Dept. of Physics, 52001, (319) 588-7100, 30" dome theater, observatory. Program info: 588-7154.

Waterloo: Grout Museum of History and Science, 503 South St., 50701, (319) 234-6357, 15" dome theater, observatory, planetarium. Open Tues.-Sat.

KANSAS

CLUBS

Lawrence: Astronomical Society of Lawrence, 1082 Malott Hall, University of Kansas, 66045, Corey Zirlin, (913) 842-2225, 25 members, observatory, 27" scope. Hotline: 864-3166.

Overland Park: Astronomical Society of Kansas City, 11305 King St., 66210, Jackie Wade, (913) 469-0135, 242 members, observatory. Hotline: 889-STAR.

Salina: Kansas Wesleyan University Observatory, 100 E. Claflin, 67401, (913) 827-5541.

Smolan: Salina Astronomy Club, 5201 S. Halstead, 67479, David Clark, (913) 668-2539, 26 members, observatory, 16" scope.

Topeka: Heartland Astronomical Research Team, P.O. Box 3938, 66604-6938, Terri A. McManus, (913) 232-3693, 5 members, observatory, 10" scope.

Topeka: Northeast Kansas Amateur Astronomers League, P.O. Box 951, 66601, Brenda Culbertson, (913) 589-2405, 50 members, observatory, 17.5" scope.

Wichita: Kansas Astronomical Observers, Wichita Children's Museum, 435 South Water, 67202, Vicki Johnston, (316) 267-2281.

Wichita: Wichita Astronomical Society, 2100 University Ave., Friends University, 67213.

PLACES

Emporia: Emporia State University, 1200 Commercial, 66801, (316) 341-5980, 30" dome theater. Open by reservation.

Great Bend: Barton County Community College Planetarium, Bissells Point Rd., 67530, (316) 792-2701, 30" dome theater, observatory.

Greensburg: Pallasite Meteorite, The Big Well, 315 South Sycamore, 67054, (316) 723-2261.

Hutchinson: Kansas Cosmosphere & Space Center, 1100 North Plum St., 67501, (316) 662-2305, 40" dome theater, observatory, planetarium, OMNIMAX, exhibits, tours. Open daily, except for Christmas Day. Program info: 1-800-397-0330.

Louisburg: Powell Observatory, Lewis-Young Park, (913) 837-5305.

Salina: Kansas Wesleyan University Observatory, 100 E. Claflin, 67401, (800) 874-1154 x300, observatory, 16" SCT. Open for monthly programs and by reservation.

Topeka: Washburn University Planetarium, 17th and College, 66621, (913) 231-1010 x1330, 24" dome theater, observatory, 12" refractor.

Wichita: Lake Afton Public Observatory, 1845 Fairmount, 67208-0032, (316) 689-3191, observatory, 16" SCT, exhibits. Program info: 794-8995.

Wichita: Omnisphere and Science Center, 220 South Main St., 67202, (316) 264-3174, 30" dome theater, exhibits. Open Tues.-Sun. Program info: 264-6178.

KENTUCKY

CLUBS

Fort Wright: Midwestern Astronomers, 1643 Elder Ct., 41011.

Golden Pond: West Kentucky Amateur Astronomers, Land Between the Lakes, 100 Van Morgan Dr., 42211-9001, Jim Boren, (615) 232-6820, 20 members, observatory, 17.5" scope.

Highland Heights: Northern Kentucky Astronomers, 2395 South Main St., 41076, Eric Costello, (606) 441-4359.

Lexington: Blue Grass Astronomical Society, 1016 Della Dr., 40504, Bradley Canon, (606) 278-6155.

Louisville: Louisville Astronomical Society, P.O. Box 20742, 40250-0742, Charles Allen, (502) 267-4074, 70 members, 23" scope.

PLACES

Berea: Weatherford Planetarium, Berea College, CPO 2326, 40404, (606) 986-9341, 30" dome theater, observatory, 16" scope.

Georgetown: Georgetown College Planetarium, 400 E. College St., 40324-1696, (502) 863-8436, 35" dome theater, observatory.

Golden Pond: Golden Pond Planetarium, Tennessee Valley Authority, Land Between the Lakes, 42211, (502) 924-5602, 40" dome theater, observatory.

Louisville: Museum of History & Science, 727 West Main St., 40202, (502) 561-6103, IMAX, exhibits. Program info: 561-6100.

Louisville: Rauch Memorial Planetarium, University of Louisville, Belknap Campus, 40292, (502) 588-6665, 30" dome theater. Program info: 588-6664.

Richmond: Hummel Planetarium, Eastern Kentucky University, 40475, (606) 622-1547, 67" dome theater, tours.

LOUISIANA

CLUBS

Baton Rouge: Baton Rouge Astronomical Society, Inc., 6348 Double Tree Ct., 70817, Craig Brenden, (504) 751-1685, 35 members, observatory, 11" scope. Hotline: 344-0535.

Shreveport: Shreveport Astronomy Society, 353 Oakley Dr., 71105, Jennie Goodwin, (318) 865-2433, 50 members, observatory, 16" scope.

Westwego: Pontchartrain Astronomy Society, 948 Ave. E, 70094, Michael D. Sandras, (504) 340-0256, 175 members, observatory, 14" scope.

PLACES

Kenner: Freeport McMoran Daily Living Science Center, 409 Williams Blvd., 70062, (504) 468-7229, 26" dome theater, observatory, 14" SCT, exhibits. Open Tues.-Sun., except major holidays.



Lafayette: Lafayette Natural History Museum, 637 Girard Park Dr., 70503, (318) 268-5544, 30' dome theater, observatory, 8" SCT, exhibits, tours.

Luling: St. Charles Parish Public Library & Planetarium, 105 Lakewood Dr., 70070, 20' dome theater, observatory, 8" SCT, tours. Open Mon., Wed., and Sat. Program info: (504) 785-8471.

New Orleans East: Louisiana Nature and Science Planetarium, Joe W. Brown Memorial Park, P.O. Box 870610, 70187, (504) 246-5672, 30' dome theater, observatory, planetarium. Open Tues.-Sun. Program info: 246-7827.

MAINE

CLUBS

Hampden: Penobscot Valley Star Gazers, 36 B Old County Rd., 04444, Dave Clark, (207) 945-3867, 18 members.

Kennebunkport: Astronomical Society of Northern New England, P.O. Box 497A, 04046, Peter Talmadge, (207) 967-5945, 62 members.

PLACES

Castine: Maine Maritime Academy, 04420, (207) 326-4311, 20' dome theater, observatory, 10" scope, planetarium.

Easton: Francis Malcolm Science Institute, P.O. Box 186, U.S. Route 1-A, 04740, (207) 488-5451, 24' dome theater, observatory, 13" Dobsonian. Open Mon.-Fri.

Fairfield: Northern Stars Planetarium, 4 Osborne St., 04937, 16' dome theater. Open by reservation. Program info: (207) 453-7668.

Lewiston: Bates College Planetarium, Dept. of Physics & Astronomy, 04240, (207) 786-6320.

Orono: Maynard E. Jordan Planetarium, University of Maine, 5781 Wingate Hall, 04469-5781, 20' dome theater, observatory, 8" refractor. Program info: (207) 581-1341.

Portland: Southworth Planetarium, University of So. Maine, 96 Falmouth St., 04103, (207) 780-4249, 30' dome theater, exhibits. Open weekends.

MARYLAND

CLUBS

Arnold: Anne Arundel Association of Amateur Astronomers, Anne Arundel Community College, 101 College Parkway, 21012.

Baltimore: Baltimore Astronomical Society, 601 Light St., 21230, Mike Hall, (410) 247-8965. Founded in 1881, 140 members.

Bel Air: Harford County Astronomical Society, P.O. Box 906, 21014, Larry Hubble, (410) 836-4155, 60 members, observatory, 16" scope.

Cumberland: Cumberland Astronomy Club, 350 Bedford St., 21502, G. Frank Simpson, (301) 722-7606, 30 members, 20" scope.

Greenbelt: Goddard Astronomy Club, Goddard Space Flight Center, Code 668.1, 20771, George W. Gliba, (301) 345-4760, 50 members, observatory, 22" scope.

Hagerstown: TriState Astronomers, Washington County Planetarium, 823 Commonwealth Ave., 21740, Jim Stanicel, Rod Martin, (301) 791-4172, 40 members.

Rockville: National Capital Astronomers, 10500 Rockville Pike, Apt. M-10, 20852-3331, Leith Holway, (301) 564-6061, 240 members, 14" scope.

Westminster: Westminster Astronomical Society, 3481 Salem Bottom Rd., 21157, Curtis W. Roelle, (410) 848-6384, 75 members.

PLACES

Annapolis: McKeldin Memorial Planetarium, St. John's College, 60 College Ave., 21401, (301) 263-2371, 24' dome theater, observatory.

Annapolis: Planetarium, U.S. Naval Academy, Luce Hall Seanav, 21402, (301) 267-3952, 40' dome theater, observatory. Program info: (410) 267-3002.

Baltimore: Community College of Baltimore Planetarium, 2901 Liberty Heights Ave., 21215, (301) 396-7994.

Baltimore: K. Brice Bryan Planetarium, College of Notre Dame, 4701 N. Charles St., 21210, (301) 435-0100, 20' dome theater, observatory, 20" reflector. Program info: (410) 532-5702.

Baltimore: Maryland Science Center, Davis Planetarium, 601 Light St., 21230, (410) 685-2370, 50' dome theater, observatory, 8" refractor, IMAX, exhibits. Open daily, except Thanksgiving and Christmas. Program info: 685-5225.

Baltimore: Space Telescope Science Institute, 3700 San Martin Dr., 21218, (301) 338-4700.

College Park: University of Maryland Observatory, 1205 Space Sciences Building, 20742, (301) 454-3001, observatory, 20" reflector.

Frostburg: Frostburg State University Planetarium,

Tawes Hall Lobby, Frostburg State University, 21532, (301) 689-4298, 24' dome theater. Open Mon.-Sat. (Sept.-May). Program info: 689-4270.

Greenbelt: NASA Goddard Space Flight Center, 20771, (301) 286-8981.

Hagerstown: Washington County Planetarium, 823 Commonwealth Ave., 21740, 30' dome theater. Open daily for school groups, Tues. for public. Program info: (301) 791-4172.

Rockville: Meadowside Nature Center, 5100 Meadowside Ln., 20855, (301) 924-4141, 20' dome theater, observatory, 8" scope.

Takoma Park: Montgomery College Planetarium, Takoma Avenue & Fenton St., 20912-4197, 24' dome theater, observatory, 8" Schmidt Cassegrain, tours. Open daily, Sept.-May. Program info: (301) 650-1463.

Worton: Kent County High School Planetarium, 25301 Lams Meadow Rd., 21678-0047, (410) 778-4540, 30' dome theater, observatory, 6" reflector, exhibits. Open daily, Sept.-June, July-Aug. by reservation. Program info: 639-7428.

MASSACHUSETTS

CLUBS

Amesbury: North Shore Amateur Astronomy Club, 12 Claire Rd., 01913, David Thomas, (508) 388-2341, 49 members, observatory, 12.5" scope.

Amherst: Amherst Area Amateur Astronomers Assn., 1403 South East St., 01002, Tom Whitney, 65 members, observatory, 18" scope. Hotline: (413) 256-6234.

Ashland: Amateur Telescope Makers of Boston, Inc., 73 Sudbury Rd., 01721, Bernard Volz, (508) 881-3614, 300 members, observatory, 16" scope.

Harwich: Cape Cod Astronomical Society, P.O. Box 56, 02645, Jim C. Carlson, (508) 432-4316, 60 members.

Monson: Springfield Stars Club, P.O. Box 54, 01057, Richard Sanderson, (413) 267-5283, 70 members, observatory, 20" scope.

Norwell: South Shore Astronomical Society, P.O. Box 267, 02061, Bill Luzader, (508) 941-6786, 45 members, observatory, 10" scope.

Plymouth: Bay Colony Astronomical Society, 7 Morton Park Rd., 02360-3554, Robert A. Johnson, 7 members, 10.1" scope.

White Horse Beach: Star Searchers Astronomy Club, P.O. Box 255, 02381-0255, Roy Zahreycian, (617) 834-9866, 60 members.

Worcester: Aldrich Astronomical Society, 10 Hickory Dr., 01609, Larry Moss, (508) 752-7146, 45 members, observatory, 12.5" scope.

PLACES

Amherst: Bassett Planetarium and Wilder Observatory, Amherst College, Dept. of Astronomy, 01002, (413) 542-2138, 30' dome theater, observatory, 18" refractor, tours. Open by reservation.

Amherst: Five College Radio Observatory, University of Massachusetts, 01002, (413) 545-2194.

Amherst: Orchard Hill Observatory, University of Massachusetts, 01002, (413) 545-0111.

Boston: Boston University, Dept. of Astronomy, 725 Commonwealth Ave., 02215, (617) 353-5700, observatory, 14" reflector, exhibits. Program info: 353-2630.

Boston: Charles Hayden Planetarium, Boston Museum, 02114-1099, (617) 589-0270, 60' dome theater, OMNIMAX, exhibits. Open daily, except Thanksgiving and Christmas. Program info: 723-2500.

Cambridge: Harvard-Smithsonian Center for Astrophysics, 60 Garden St., 02138, (617) 495-7461, observatory, 9" refractor. Program info: 491-1497.

Cambridge: Wallace Observatory, MIT, Building 54-410, 02139, (617) 253-9317, observatory, 24" scope, tours.

Deerfield: Peter C. Andrews Planetarium, Deerfield Academy, 01342, (413) 772-0241 x3470, 40' dome theater, observatory, 10" SCT. Open by reservation.

Fall River: B.M.C. Durfee High Planetarium/Observatory, 360 Elsbree St., 02720, 25' dome theater, observatory. Program info: (508) 675-8170.

Nantucket: Maria Mitchell Association, 2 Vestal St., 02554, (508) 228-9198. Program info: 228-9273.

Norton: Wheaton College Observatory, 02766, Timothy Barker, (509) 285-8200 ext. 5617, observatory, 12" SCT. Program info: (508) 285-8200 ext. 5935.

Springfield: Springfield Science Museum, 236 State St., 01103, (413) 733-1194, 34' dome theater, observatory, 20" SCT, exhibits. Open second Fri. each month.

Wenham: Woodside Planetarium and Observatory, 13 Friend Ct., 01984, 14' dome theater, observatory, 14" SCT. Open by reservation. Program info: (508) 468-4815.

Westford: Haystack Observatory, Route 40, 01886, (508) 692-4764.

Williamstown: Hopkins Observatory/Milham Planetarium, Williams College, Main St., 01267, (413) 597-2105, 16' dome theater, observatory, 24" scope. Program info: 597-2188.

Worcester: New England Science Center, 222 Harrington Way, 01604, (617) 791-9211, 40' dome theater, observatory, 14" SCT, exhibits. Open daily until 5:00 p.m. Program info: (508) 791-9211.

MICHIGAN

CLUBS

Alpena: Huron Amateur Astronomers, P.O. Box 53, 49707.

Brighton: Friends United Through Astronomy, 8191 Woodland Shore, Lot #12, 48116, Gary Anderson, (313) 227-9347.

Detroit: Detroit Astronomical Society, 14298 Lauder, 48227, Jack Brisbin, (313) 455-7827, 50 members. Hotline: (313) 837-0130.

Dryden: Seven Ponds Astronomy Club, Seven Ponds Nature Center, 3854 Crawford Rd., 48428, John E. Lines, (810) 969-2790, 10" scope.

East Lansing: Capital Area Astronomy Club, Abrams Planetarium, Michigan State University, 48824, David Batch, 60 members.

Flint: Genesee Astronomical Society, c/o Robert Longway Planetarium, 1310 E. Kearsley St., 48503, Richard Walker, (313) 627-9524, 25 members.

Hillsdale: Astronomical Society of Hillsdale County, 500 North Dunes Rd., 49242, Pat Calligan, (517) 439-1295, 25" scope.

Holland: Shoreline Amateur Astronomical Association, 16528 James St., 49424-6047, Mark Logsdon, (616) 399-3448, 16 members.

Hudson: Astronomical Society of Lenawee County, P.O. Box 70, 49247, Wes Boyd, (517) 547-7402, 18 members, observatory, 6" scope.

Kalamazoo: Kalamazoo Astronomical Society, Kalamazoo Public Museum, 315 South Rose St., 49001, Eric Schreier, (616) 382-0326, 30 members.

Lowell: Grand Rapids Amateur Astronomical Association, 3308 Kissing Rock Road SE, 49331, Evelyn Marron, (616) 897-7880, 205 members, observatory, 17" scope. Hotline: 897-7065.

Marquette: Marquette Astronomical Society, P.O. Box 761, 49855, Brian Halbrook, (906) 249-1465, 50 members, observatory, 17.5" scope.

Midland: Sunset Astronomical Society, 4300 Washington, 48642, Bill Albe, (517) 835-4142, 30 members.

Muskegon: Muskegon Astronomical Society, P.O. Box 204, 49443, Dennis Allen, (616) 798-7860, observatory, 12.5" scope.

Petersburg: Toledo Astronomical Association, 8534 Covert Rd., 49270, Courtney Earhart, (313) 856-6204, 35 members, observatory, 12" scope.

Plymouth TWP: Astronomical Society of Michigan, 11422 Waverly Dr., 48170, Michael O. Best, (313) 459-2378, 324 members.

Rochester: Dinosaur Hill Astronomical Society, 502 Whims Ln., 48306, Mike Bennett, 18 members, open to the public, 17.5" scope.

Traverse City: Grand Traverse Astronomical Society, 6003 Secor Rd., 49684, George Veldman, (616) 946-8649, 40 members, observatory, 14" scope.

Warren: Warren Astronomical Society, P.O. Box 1505, 48090-1505, Robert Halsall, (313) 781-6784, 100 members, observatory, 12.5" scope.

Ypsilanti: EMU Astronomy Club, 303 Strong Hall, Eastern Michigan University, 48197, Norbert Vance or Jeff Wilson, 20 members, observatory, 10" scope. Hotline: (313) 487-3033.

PLACES

Alpena: Jesse Besser Museum, 491 Johnson St., 49707, 30' dome theater, exhibits, tours. Program info: (517) 356-2202.

Ann Arbor: University of Michigan Exhibit Museum Planetarium, 1109 Geddes Ave., room 4506, 48109-1079, (313) 767-1381, 18' dome theater, exhibits, tours. Program info: 763-6085.

Battle Creek: Gardner Memorial Planetarium, Kingman Museum of Natural History, West Michigan Avenue at 20th St., 49017, (616) 965-5117, 16' dome theater, observatory.

Bloomfield Hills: Cranbrook Institute of Science, 1221 N. Woodward Ave., 48303, (313) 645-3235, 30' dome theater, observatory, 6" refractor, exhibits. Program info: 645-3200.

Detroit: Children's Museum/Detroit Public Schools, 67 East Kirby, 48202, (313) 494-1212, 14.5' dome theater. Open by reservation. Program info: 494-1210.

Detroit: Detroit Science Center, 5020 John R St., 48202, (313) 577-8430.

East Lansing: Abrams Planetarium, Michigan State University, 48824-1324, 50' dome theater, observatory, 24" scope, exhibits. Program info: (517) 355-4672.

Flint: Robert T. Longway Planetarium, 1310 E. Kearsley St., 48503, (810) 760-1181, 60' dome theater, exhibits, tours. Open by reservation.

Grand Rapids: James C. Veen Observatory, 3308 Kissing Rock Road SE, Lowell, 49331, Evelyn Maron, observatory, 12.5" Newtonian, exhibits, tours. Open by reservation. Program info: (616) 897-7065.

Grand Rapids: Roger B. Chaffee Planetarium, Grand Rapids Public Museum, 54 Jefferson, S. E., 49503, (616) 456-3985, 30' dome theater, observatory, exhibits. Open by reservation. Program info: 456-3200.

Jackson: Michigan Space Center, 2111 Emmons Rd., 49201, exhibits, tours. Open daily; winter hours restricted. Program info: (517) 787-4425.

Kalamazoo: Kalamazoo Public Museum Planetarium, 315 South Rose St., 49001, (616) 345-7092, 30' dome theater, observatory, 8" reflector. Open daily; no public shows on Mon., Tues., or Thurs. Program info: 382-6873.

Lansing: Impression Five Science Museum, 200 Museum Dr., 48933, (517) 485-8116, exhibits. Open daily, except major holidays. Program info: 485-8115.

Lansing: Lansing Community College Planetarium, 419 N. Capitol Ave., 48910, (517) 373-7284, 39' dome theater, observatory, 10" scope.

Marquette: Shiras Planetarium, Marquette Senior High School, 1203 W. Fair Ave., 49855, (906) 225-4250, 30' dome theater, exhibits. Open daily, except holidays. Program info: 225-4204.

Mount Pleasant: Brooks Observatory, Physics Department, Central Michigan University, 48859, (517) 774-3321, observatory, 14" SCT.

Muskegon: Carr-Fles Planetarium, Muskegon Community College, 221 S. Quarterline Rd., 49442, (616) 777-0289, 24' dome theater, tours. Open Mon.-Fri.

Ypsilanti: Sherzer Observatory, Eastern Michigan University, Physics & Astronomy Dept., 303 Strong Hall, 48197, (313) 487-4144, observatory, 10" refractor, tours. Program info: 487-3033.

MINNESOTA

CLUBS

Austin: Cedar River Astronomy Club, 407 15th Street SE, 55912, Keith Snyder, (507) 433-1903, 12 members, observatory, 10" scope.

Brainerd: North Star Astronomy Club, 606 South 8th St., 56401-4118, David Starkka, (218) 829-4029.

Duluth: Arrowhead Astronomical Society, Alworth Planetarium, Univ. of Minnesota-Duluth, 55812, Glenn Langhorst, (218) 389-6212, 30 members.

Moorhead: Fargo-Moorhead Astronomical Society, P.O. Box 28, Concordia College, 56560, Jeff Struck, (218) 739-3453, 12 members, open to the public, 16" scope.

Northfield: Cannon Valley Astronomical Society, 1225 - 330th Street East, 55057, Steve Messner, (507) 645-8347.

Pillager: Orion's Belt Astronomy Club, P.O. Box 92, 56473-0092, David Starkka, (218) 746-3336, 35 members.

St. Paul: Minnesota Astronomical Society, c/o Science Museum of Minnesota, 30 East 10th St., 55101, Stuart Levy, (612) 729-9289, 218 members, observatory, 16" scope. Hotline: 643-4092.

Willmar: Willmar Astronomy Club, 622 9th Street SW, 56201, Patrick J. Thibault or Randy Wehler, (612) 235-8747, 10 members.

PLACES

Duluth: Alworth Planetarium, 10 University Dr., Univ. of Minnesota-Duluth, 55812, (218) 726-7129, 32' dome theater, observatory.

Hibbing: Paulucci Space Theater, Arrowhead Community College, Hwy 169 & East 23rd St., 55746, (218) 262-6718, 40' dome theater, observatory, 8" SCT, Cinema 360°. Open daily, by reservation

during school year, and on weekends. Program info: 262-6720.

Marshall: Southwest State University Planetarium, 56258, (507) 537-6196, 30' dome theater, observatory.

Minneapolis: Minneapolis Planetarium, 300 Nicollet Mall, 55401, (612) 372-6543, 40' dome theater, exhibits, tours. Open daily, except for some holidays. Program info: 372-6644.

Moorhead: Moorhead State University Planetarium, 8th Ave. and 11th St. S., Bridges Hall 167, 56563, (218) 236-2904, 30' dome theater, observatory, 16" SCT. Program info: 236-3982.

New Ulm: Dr. Martin Luther College, 1884 College Heights, 56073, (507) 354-8221, 12' dome theater, observatory, 18" Dobsonian. Open by reservation. Program info: 354-3922.

St. Cloud: SCSU Observatory and Planetarium, St. Cloud State University, 56301, (612) 255-2013, 30' dome theater, observatory, 11" SCT. Open by reservation.

St. Paul: Macalester College Planetarium, 1600 Grand Ave., 55105, (612) 696-6000, 22' dome theater, observatory, 25" scope. Not open to the public. Program info: 696-6383.

St. Paul: Science Museum of Minnesota, McKnight Omnitheater, 30 E. 10th St., 55101, (612) 291-9403. Open daily.

MISSISSIPPI

CLUBS

French Camp: Rainwater Astronomers Association, French Camp Academy, 1 Fine Place, 39745, James Hill, (601) 547-6970, 73 members, observatory, 32" scope.



Greenville: Galileo Group, 242 S. Poplar St., 38701, Philip A. Vazzana, 10 members.

Pearl: Jackson Astronomical Association, 703 Lomont St., 39208, Walter Rebmann, (601) 939-9287, 37 members, observatory, 25" scope.

PLACES

Bay St. Louis: NASA John C. Stennis Space Center, Stennis Space Center, 39529, (601) 688-2370.

French Camp: Rainwater Observatory and Planetarium, 1 Fine Place, 39745, 20' dome theater, observatory, 32" reflector, exhibits, tours. Open by reservation. Program info: (601) 547-6865.

Goodman: Holmes Community College Observatory, Dept. of Science and Mathematics, Holmes Community College, 39079, (601) 472-2312 x64, 10' dome theater, observatory, 14" SCT. Open by reservation.

Hattiesburg: University of Southern Mississippi Observatory, Dept. of Physics & Astronomy, 39406, (601) 266-4934.

Jackson: Millsaps College Observatory, 1701 North State St., 39210, (601) 974-1000.

Jackson: Russell C. Davis Planetarium, 201 East Pascagoula St., 39205, (601) 960-1550, 60' dome theater, observatory, Cinema 360°. Open daily, except holidays. Program info: 960-1540.

Oxford: Kennon Observatory, University of Mississippi, Dept. of Physics and Astronomy, 38677, (601) 232-7046, observatory, 15" refractor.

MISSOURI

CLUBS

Blue Springs: Astronomical Society of Kansas City, P.O. Box 400, 64015, Carroll Iorg, (816) 444-4878, 245 members, observatory, 30" scope. Hotline: 889-STAR.

Chesterfield: St. Louis Astronomical Society, P.O. Box 613, 63006-0613, Lois Fitter, (314) 532-5648, 300 members. Hotline: 758-7587.

Columbia: Central Missouri Amateur Astronomers, 261 Stardust Ln., 65201, Val Germann or John Winegar, (314) 474-4215, 30 members, observatory, 12" scope.

Dawn: North Central Missouri Amateur Astronomers, Route 1 Box 111, 64638, Jim Jones.

Florissant: McDonnell Douglas Amateur Astronomy Club, 3491 Heather Trail Dr., 63031, Richard Melvin, (314) 569-4773.

Hannibal: Mark Twain Astronomical Society, 45 Pioneer Trail, 63401, William J. Remington.

Riverside: Prairie View Astronomical Society, 931 NW Valley Ln., 64150.

PLACES

Columbia: University of Missouri, 223 Physics Building, 65211, (314) 882-3335, observatory, 16" SCT. Open Fri. evenings in summer.

Kansas City: Kansas City Museum Planetarium, 3218 Gladstone Blvd., 64123, 20' dome theater, exhibits, tours. Open Tues.-Sun. Program info: (816) 483-8300.

Kansas City: Powell Gardens Observatory, 9912 Raytown Rd., 64134, observatory, 8" refractor.

St. Louis: St. Louis Science Center, 5050 Oakland Ave., 63110, (314) 289-4455, 60' dome theater, OMNIMAX, exhibits. Program info: 289-4444.

MONTANA

CLUBS

Missoula: Western Montana Astronomical Association, 9285 Miller Creek Rd., 59803, Bill Elison, (406) 251-4825.

PLACES

Bozeman: Taylor Planetarium, Museum of the Rockies, 600 W. Kagy Blvd., 59717, (406) 994-2251, 40' dome theater, observatory, 13" scope, exhibits.

NEBRASKA

CLUBS

Lincoln: Prairie Astronomy Club, P.O. Box 80553, 68501, Jason Stahl or John Bruce, (402) 423-4912, 78 members, observatory, 14" scope. Hotline: 465-2246.

Omaha: Omaha Astronomical Society, 5025 S 163 St., 68135, Bill Jacobsen.

PLACES

Chadron: Chadron State College Planetarium, 10th & Main St., 69337, (308) 432-6219, 25' dome theater, observatory, 25" scope, tours. Open by reservation. Program info: (800) CHA-DRON.

Fremont: Lueninghoener Planetarium, Midland Lutheran College, 900 N. Clarkson, 68025, (402) 721-6328 x6328, 30' dome theater, observatory. Open by reservation.

Hastings: J.M. McDonald Planetarium and Hastings Museum, 1330 North Burlington Ave., 68901, (402) 461-2399, 24' dome theater, observatory, 14" SCT, IMAX. Program info: 461-2395.

Kearney: University of Nebraska at Kearney, 905 W. 25th St., 68849-0001, (308) 234-8283, 25' dome theater, observatory, 16" reflector. Open by reservation. Program info: 234-8675.

Lincoln: Behlen Observatory, Dept. of Physics & Astronomy, University of Nebraska, 68588, (402) 472-2770, observatory, 30" SCT. Open for group reservations.

Lincoln: Hyde Memorial Observatory, South Shore Road-Holmes Park, 68506, (402) 471-7960, observatory, 14" SCT. Open Sat. evenings and by group reservation. Program info: 471-7094.

Lincoln: Jensen Planetarium, Nebraska Wesleyan University, 5000 Saint Paul Ave., 68504-2796, (402) 465-2371, 30' dome theater, observatory, planetarium. Not open to public. Program info: 465-2246.

Lincoln: Ralph Mueller Planetarium, University of Nebraska, 213 Morrill Hall, 68588-0332, 34' dome theater. Open Tues.-Fri. by reservation, Sat. and Sun. for public shows. Program info: (402) 472-2641.

Omaha: Durham Science Center and Kountze Planetarium, University of Nebraska at Omaha, 68th and Dodge St., 68182, (402) 554-3727, 33' dome theater, observatory. Open Fri.-Sun.

Wayne: Fred G. Dale Planetarium, Wayne State College, Box 77, Wayne State College, 68787, 30' dome theater. Open by reservation. Program info: (402) 375-7343.

NEVADA

CLUBS

Elko: Elko Nevada Astronomical Society, 550 South 12th #22, 89801, Leonard Seymour, (702) 738-7916, 20 members.

Las Vegas: Las Vegas Astronomical Society, Clark County Community College, 3200 East Cheyenne Ave., 89030, Roger Debevc, (702) 253-5827, 60 members, 24" scope.

Reno: Astronomical Society of Nevada, c/o Fleischmann Planetarium, 1650 N. Virginia St., Univ. of Nevada, 89557, Adam Kremers, 70 members, observatory, 24" scope.

PLACES

North Las Vegas: Community College of Southern

Nevada Planetarium, 3200 E. Cheyenne Ave., 89030-4296, (702) 643-6060 x308, 30' dome theater, observatory, 8" SCT, Cinema 360°. Open Sat.-Wed. Program info: 644-5059.

Reno: Fleischmann Planetarium, University of Nevada-Reno, 1650 N. Virginia St., MS-272, 89557, (702) 784-4812, 30' dome theater, observatory, 12.5" reflector, Cinema 360°, exhibits. Program info: 784-4811.

NEW HAMPSHIRE

CLUBS

Keene: Keene Amateur Astronomers Inc., 131 Carroll St., 03431, Paul Fisher, (603) 352-6393, observatory, 13.1" scope.

Penacook: New Hampshire Astronomical Society, 22 Center St., 03303-1448, Nelson D. LaClair, (603) 753-9225, 60 members.

Walpole: Springfield Telescope Makers, RR #2 Box 68A, 03608, Bob Morse, (603) 352-0640, 40 members, 13" scope.

PLACES

Concord: Christa McAuliffe Planetarium, 3 Institute Dr., 03301, (603) 271-7831, 40' dome theater, observatory, 13" reflector, exhibits. Open Tues.-Sun. Program info: 271-7827.

Durham: University of New Hampshire Observatory, DeMeritt Hall, 03824, observatory, 14" SCT. Open twice monthly. Program info: (603) 862-1950.

Hanover: Shattuck Observatory, Dartmouth College, Physics and Astronomy Dept., Wilder Laboratory, 03755-3528, (603) 646-2034. Open by reservation. Program info: 646-3384.

Plymouth: Plymouth State College Planetarium, Natural Science Department, 03264, (603) 535-2325, 20' dome theater. Open by reservation. Program info: 535-2748.

NEW JERSEY

CLUBS

Boonton: Sheep Hill Astronomical Association, P.O. Box 111, 07054, Evert Bono, (201) 335-5990, 29 members, observatory, 16" scope.

Clifton: North Jersey Astronomical Group, P.O. Box 4021, Allwood Station, 07012, Ruth Koenig, (201) 340-4640, 65 members. Hotline: 614-9220.

Closter: Rockland Astronomy Club, 73 Haring St., 07624, Donald Urban, (201) 768-6575, 200 members, observatory, 24" scope. Hotline: (914) 786-7730.

Cranford: Amateur Astronomers Inc., W.M. Sperry Observatory, 1033 Springfield Ave., 07016, George Chaplenko, (908) 549-0615, 400 members, observatory, 24" scope. Hotline: 276-STAR.

East Hanover: Morris Museum Astronomical Society, 6 Deforest Ave., 07936, Ronald Russo, 54 members.

Glassboro: Tychonius Observers, Rowan College of New Jersey, Dept. of Physical Sciences, 08028, W.C. Woods, Jr., (609) 863-6336, 20 members, observatory, 6" scope.

GloUCESTER: Willingboro Astronomical Society, P.O. Box 371, 08030, David Heunheuser, (609) 456-3870, 30 members, observatory, 14" scope.

High Bridge: New Jersey Astronomical Association, P.O. Box 214, 08829-0214, Stewart Rorer or Robert Cava, (908) 638-8500, 160 members, observatory, 26" scope.

Holmdel: STAR Astronomy Society, P.O. Box 547, 07733, Joseph Cascella, 40 members.

Jamesburg: Concordia Astronomy Club, P.O. Box 22, 08831-0022, Lee Domash, (609) 655-8883, 109 members.

Newton: Montclair Telescope Club Inc., RD #3, Box 113, 07860, James Burnell, (201) 579-3922, 30 members.

Princeton: Amateur Astronomers Association of Princeton, P.O. Box 2017, 08640, Victor Belanger, (609) 448-8598, 85 members, observatory, 12.5" scope.

Toms River: Astronomical Society of the Toms River Area, Novins Planetarium, Ocean County College, 08754-2001, R. Erik Zimmerman, 55 members.

West Milford: The Dark Sky Observers, 15E Concord Rd., 07480, Ginger Payne, (201) 728-0086, 12 members.

PLACES

Allendale: Northern Highlands Planetarium, Hillside Ave., 07401, 25' dome theater, observatory. Program info: (201) 934-1087.

Jersey City: Liberty Science Center, 251 Phillip St., 07304-4629, (201) 451-0006.

Mountainside: Trailside Nature and Science Center,

Coles Ave. and New Providence Rd., 07092, (908) 789-3670, 20' dome theater, exhibits, tours.

Newark: Dreyfuss Planetarium, Newark Museum, 49 Washington St., 07101-0540, (201) 596-6609, 24' dome theater, observatory. Open Mon.-Fri. Program info: 596-6611.

Randolph: County College of Morris Planetarium, 214 Center Grove Rd., 07869, 33' dome theater, observatory, 7" Maksutov, exhibits. Program info: (201) 328-5755.

Toms River: Robert J. Novins Planetarium, Ocean County College, P.O. Box 2001, 08754-2001, (908) 255-0343, 40' dome theater. Open daily, except weekends in July and Aug. Program info: 255-0342.

Trenton: New Jersey State Museum Planetarium, 205 West State St., 08625-0530, (609) 292-6333, 40' dome theater, exhibits, tours. Open Tues.-Sun. Program info: 292-6303.

NEW MEXICO

CLUBS

Albuquerque: Albuquerque Astronomical Society, P.O. Box 54072, 87153-4072, George Pellegrino, (505) 821-8516, 195 members, observatory, 16" scope.

Cloudcroft: Alamogordo Amateur Astronomers, 1502 Jefferson Ave., 83110, Howard J. Brewington, (505) 687-3970, 25 members, observatory, 12.5" scope.

Clovis: Clovis Astronomy Club, 216 Sandzen, 88101, Robert J. Reithel, (505) 762-7183, 4 members.

Hobbs: Lea County Astronomical Society, NMJC Science Building, 5317 Lovington Highway, 88240, Dr. V.G. Berner, (505) 392-4510.

Las Cruces: Astronomical Society of Las Cruces, 2612 Comstock, 88001, Vincent Dovydaitis, (505) 522-5754, 85 members, observatory, 12.5" scope.

Santa Fe: Astronomy Club of Santa Fe, Santa Fe Children's Observatory, Route 19, Box 90-DJ, 87505, Michael Robinson, 50 members, observatory, 16" scope.

Socorro: New Mexico Tech Astronomy Club, c/o P.O. Box 0, 87801, Jonathan C. Spargd, (505) 835-1606, 40 members, observatory, 14" SCT.

PLACES

Alamogordo: Clyde W. Tombaugh Space Theater, Top of Highway 2001, P.O. Box 533, 88310, (505) 437-2840, 40' dome theater, OMNIMAX. Program info: (800) 545-4021.

Albuquerque: University of New Mexico Observatory, Dept. of Physics and Astronomy, 800 Yale Boulevard NE, 87131, (505) 277-2616, observatory, 12" SCT. Open Fri. evenings in spring and fall; not open in summer.

Farmington: San Juan College Planetarium, San Juan College, 4601 College Blvd., 87402, (505) 599-0361, 24' dome theater, 8" SCT, exhibits, tours. Open by reservation.

Roswell: Robert H. Goddard Planetarium, 11th & N. Main, 88201, (505) 624-6744, 40' dome theater, observatory, 10" scope, exhibits, tours. Open daily in summer, one week per month during school year, and for group reservations.

Sapello: Star Hill Inn, Box 1a, 87745, (505) 425-5605, observatory, 17.5" scope, tours. Open by reservation.

Socorro: National Radio Astronomy Observatory-Very Large Array, P.O. Box O, 87801, (505) 835-7000, exhibits, tours. Open daily.

Sunspot: Apache Point Observatory, P.O. Box 59, 88349, (505) 437-6822. Open daily.

Sunspot: ARC Telescope, New Mexico State University, Dept. of Astronomy, Box 30001, Dept. 45000, Las Cruces, 88003, (505) 646-4438. Open in summer.

Sunspot: National Solar Observatory, Sacramento Peak, 88349, (505) 434-7000, observatory, 64" scope. Open daily.

NEW YORK

CLUBS

Black River: Northern New York Astronomical Society, RD 1, Box 149, 13612, Bill Mack, (315) 773-5807.

Buffalo: Buffalo Astronomical Association Inc., Buffalo Museum of Science, Humboldt Parkway, 14211, Bill Smith, (716) 664-0841, 85



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members, observatory, 20" scope. Hotline: 457-3104.

Chappaqua: Westchester Amateur Astronomers, P.O. Box 111, 10514, Robert Davidson, (914) 238-4533, 80 members, observatory, 24" scope. Hotline: 734-1741.

Clinton: Mohawk Valley Astronomical Society, Hamilton College, Box 674-B, 13323, Richard Somer, (315) 853-6056, observatory, 11" scope.

Geneseo: American Meteor Society, SUNY.

Getzville: Association of Observational Astronomers of Western New York, 1955 Hopkins Rd., 14068, Carl Milazzo, (716) 688-4869.

Irvington: Polish Amateur Astronomy Club (USA), 9 Leslie Pl. 2nd Floor, 07111, Dan Kononczuk, (201) 374-6343.

Jamestown: Marshal Martz Memorial Astronomical Assoc., Martz Planetarium & Observatory, 28 North Main St., 14701, Tom Bemus, (716) 386-4566, 50 members, observatory, 30" scope. Hotline: 664-4506.

Kirkville: Assoc. of Solar, Planetary & Lunar Observers, P.O. Box 95, 13082, Jim Moeller, 14 members.

Lockport: Lockport Astronomy Association, 7053 Northview Dr., 14094, Richard Lahrs, (716) 433-4706, observatory, 12" scope.

Massapequa: Astronomical Society of Long Island, 13 Lincoln Ave., 11758, Ronald Rizzi, (516) 795-3072, 125 members.

Merrick: Amateur Observers' Society of New York, P.O. Box 500, 11566-0500, Sue Farrell, (516) 623-7141, 50 members, 17" scope.

Newpaltz: Mid-Hudson Astronomical Association, SUNY, 12561, Tom Rankin, (914) 473-7572, founded 1986, 100 members, 13" scope.

New York: Amateur Astronomers Association, 1010 Park Ave., 10028, John Marshall, (212) 535-2922, observatory, 17.5" scope.

Ray Brook: Tri-Lakes Astronomical Society, P.O. Box 33, 12977-0033, John R. Cogan, (518) 891-4572, 20 members.

Rochester: Astronomy Section, Rochester Academy of Science, P.O. Box 20292, 14602, Matthew Sinicola, 103 members, observatory, 12" scope. Hotline: (716) 987-5330.

Rochester: RIT Astronomy Club, Rochester Institute of Technology, Dept. of Physics - 08, 14623.

Schenectady: Albany Area Amateur Astronomers, 1529 Valencia Rd., 12309, Bob Mulford, (518) 374-8744, 120 members, 18" scope.

Southold: Custer Institute Observatory, Main Bayview Rd., P.O. Box 1204, 11971, Barbara Lebkuecher or Eric Barnes, (516) 321-5679, 150 members, observatory, 6" scope. Hotline: 765-2626.

Staten Island: Astronomical Society of New York City, 153 Arlo Rd., 10301, T.W. Hamilton, (718) 727-1967.

Syracuse: Syracuse Astronomical Society Inc., 1115 East Colvin St., 13210, Joe Italiano, (315) 475-7032, 110 members, observatory, 16" scope. Hotline: 472-2111.

Valley Stream: Valley Stream Astronomical Society, 14 Charles St., 11580-2217.

Vestal: Kopernik Astronomical Society, Kopernik Space Education Center, 698 Underwood Rd., 13850, Jay Edwards, (607) 748-3685, 150 members, observatory, 20" scope.

West Seneca: Southtowns Astronomy Club, 145 Woodward, 14224, Rhonda Garbowski, (716) 649-6759.

PLACES

Alfred: Stull Observatory, Alfred University, 14802, (607) 871-2208, observatory, 32" reflector. Open Fri. (Sept.-Apr.) and Thurs. (May-July). Program info: 871-2270.

Binghamton: Robertson Center for the Arts and Sciences/Link Planetarium, 30 Front St., 13905, (607) 772-0660, 30" dome theater, observatory, 14" SCT. Open Tues.-Sun.

Bronx: Northeast Bronx Planetarium, 750 Baychester Ave., 10475, 40" dome theater. Open by reservation. Program info: (718) 904-5520.

Brooklyn: Edwin P. Hubble Planetarium, 1600 Avenue L, 11230, 24" dome theater, observatory. Open by reservation. Program info: (718) 258-9283, x492.

Buffalo: Whitworth Ferguson Planetarium, Buffalo State College, 1300 Elmwood Ave., 14222-1095, (716) 878-4911, 24" dome theater, tours, exhibits. Open by reservation.

Centerport: Vanderbilt Planetarium, 180 Little Neck Rd., 11721, 60" dome theater, observatory, 16" SCT, exhibits, tours. Program info: (516) 854-5544.

Flushing Meadows-Corona Park: New York Hall of Science, 47-01 111th St., 11368, (718) 699-0005, planetarium, exhibits. Open Mon. and Tues. for groups.

Geneseo: SUNY-GENESEO Telescope Facility, 1 College Circle, 14454, (716) 245-5282, observatory, 14" SCT. Open by reservation, not open in summer.

Herkimer: Herkimer County BOCES Planetarium, 400 Gros Blvd., 13350, 33" dome theater, observatory, 8" reflector. Open by reservation. Program info: (315) 867-2000.

Ithaca: Cornell University Observatory, Dept. of Astronomy, Space Sciences Bldg., 14850, (607) 255-4935, observatory, 16" reflector. Open every clear Fri.

Ithaca: Spacecraft Planetary Imaging Facility, 317 Space Sciences Building, Cornell University, 14853-6801, (607) 255-3833. Open in summer.

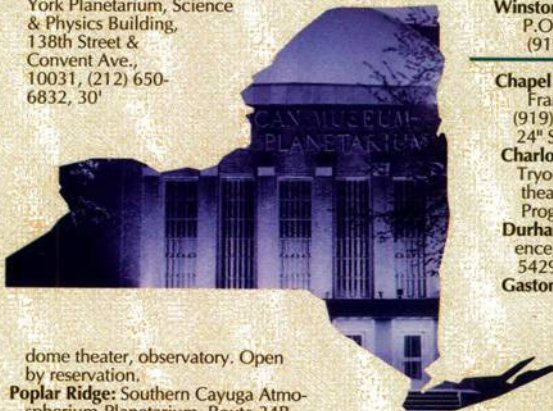
Long Island: Plainfield Planetarium, Packard Middle School, N. Idaho, N. Massapequa, 11757, (516) 755-5723, 24" dome theater, observatory, 8" SCT, tours. Open by reservation. Program info: 755-5700.

Middle Island: Longwood District Planetarium, 41 Yaphank Middle Island Rd., 11953, 30" dome theater, observatory, 6" scope. Open by reservation. Program info: (516) 345-2741.

Newpaltz: John R. Kirk Planetarium, State University College, CSB 28, 12561, (914) 257-3818, 24" dome theater, observatory, 8" scope. Open by reservation. E-mail: kirkstar@npvm.newpaltz.edu.

New York: American Museum/Hayden Planetarium, Central Park West at 81st St., 10024-5192, (212) 769-5900, 75' dome theater, exhibits. Program info: 769-5100.

New York: City College of New York Planetarium, Science & Physics Building, 138th Street & Convent Ave., 10031, (212) 650-6832, 30'



dome theater, observatory. Open by reservation.

Poplar Ridge: Southern Cayuga Atmosphere-Planetarium, Route 34B, 13139, 30" dome theater, observatory, 6" scope, exhibits. Open by reservation (July and Aug.). Program info: (315) 364-8426.

Potsdam: Potsdam College Planetarium, Pierrepont Ave., 13676, (315) 267-2284, 24" dome theater, observatory. Open by reservation. Program info: 267-2286.

Rochester: Strassenburgh Planetarium, Rochester Museum and Science Center, 657 East Ave., 14603, (716) 271-4320, 65' dome theater, observatory, 12.5" reflector, exhibits. Program info: 442-7171.

Rochester: University of Rochester, Physics and Astronomy Dept., Wilson Blvd., Building B&L 206, 14627, (716) 275-4351, observatory, 24" SCT, tours. Open by reservation. Program info: 275-0539.

Schenectady: Schenectady Museum and Planetarium, Nott Terrace Heights, 12308, (518) 382-7890, 30" dome theater, observatory, 8" reflector, exhibits, tours. Open Tues.-Sun.

Staten Island: Wagner College Planetarium, 631 Howard Ave., Grymes Hill, 10301, 30" dome theater, observatory. Open Mon.-Fri. Program info: (718) 390-3432.

Syracuse: Museum of Science & Technology, 500 S. Franklin St., 13202, (315) 425-9068, 24" dome theater, exhibits, tours. Program info: 425-0747.

Troy: The Junior Museum, 282 5th Ave., 12182, (518) 235-2120, 12" dome theater, observatory. Open in summer.

Yonkers: Andrus Planetarium, Hudson River Museum of Westchester, 511 Warburton Ave., 10701, (914) 963-4550, 40" dome theater, observatory, 8" reflector, exhibits, tours. Open Wed.-Sun. Program info: 963-2139.

NORTH CAROLINA

Albemarle: Stanly County Astronomical Society, P.O. Box 1269, 28001-1269, Herbert Hartley, (704) 982-3728.

Asheville: Starfax Association, P.O. Box 6084, 28816, (704) 254-4470, Timothy Jordan.

Castle Hayne: Cape Fear Astronomy Club, 110

Linville Dr., 28429, Paul Petty, (919) 675-2952, 30 members.

Charlotte: Charlotte Amateur Astronomers Club, 245 Timber Ln., 28105, Gayle H. Riggsbee, (704) 846-3136, 80 members, observatory, 17.5" scope.

Columbus: Foothills Astronomical Society, P.O. Box 584, 28722, Randy L. Flynn, (704) 894-2372, 12 members, 13" scope.

Fayetteville: Astronomy Club of Cumberland County, 2308 Colgate Dr., 28304, Allen Faircloth, (919) 485-8515.

Gastonia: Gaston Astronomy Club, P.O. Box 953, 28054, Larry Benefield, (704) 825-5341.

Goldboro: Eastern Carolina Astronomy Club, 1607 Munroe Ln., 27543, (919) 778-3377.

Granite Falls: Catawba Valley Astronomy Club, 5026 Poplar View Ln., 28630, Greg Kirby, (704) 396-7656, 50 members, observatory, 10" scope.

Greensboro: Greensboro Astronomy Club, Natural Science Center, 4301 Lawndale Dr., 27408, Roger Joyner, (910) 288-3769, 32 members.

Raleigh: Raleigh Astronomy Club, P.O. Box 10643, 27605, Mark Lang, 50 members, observatory, 24" scope. Hotline: (919) 460-7900.

Salisbury: Astronomical Society of Rowan County, 3021 Old Mocksville Rd., 28144, Ellen H. Trexler, (704) 636-1399, 23 members.

Thomasville: Thomasville Area Astronomy Club, 918 Alice Dr., 27360, Delbert Houston, (919) 431-5062.

Troutman: Piedmont Amateur Astronomers, Route 2, Box 181, 28166, Ronnie Sherrill, (704) 528-9316, 19 members.

Winston-Salem: Forsyth Astronomical Society, P.O. Box 30128, 27130-0128, Jeff Poplin, (919) 765-0677, 36 members.

PLACES

Chapel Hill: Morehead Planetarium, 200 E. Franklin St., Univ. of North Carolina, 27514, (919) 962-1236, 68' dome theater, observatory, 24" SCT, exhibits. Program info: 549-6863.

Charlotte: The Discovery Place Inc., 301 North Tryon St., 28202, (704) 372-6261, 24' dome theater, observatory, 8" scope, OMNIMAX. Program info: 845-6664.

Durham: North Carolina Museum of Life & Science, 433 Murray Ave., 27704, (919) 220-5429.

Gastonia: Schiele Museum of Natural History and Planetarium, 1500 East Garrison Blvd., 28052, (704) 866-6922, 50' dome theater, Cinema 360°. Open Tues.-Sun. Program info: 866-6900.

Greensboro: Three College Observatory, Dept. of Physics and Astronomy, University of North Carolina at Greensboro, 27412, (919) 334-5669, observatory, 32" SCT. Open by reservation.

Greensboro: Edward Zane Planetarium, The Natural Science Center, 4301 Lawndale Dr., 27455, (910) 288-3769, 40' dome theater. Open daily.

Hickory: Catawba Science Center, 243 3rd Avenue NE, P.O. Box 2431, 28603, (701) 322-8169. Open Tues.-Sun.

Hudson: Caldwell Community College Planetarium, 1000 Hickory Blvd., 28638, (704) 726-2200, 20' dome theater, observatory. Open by reservation. Program info: 726-2316.

Lumberton: Robeson Science & Technology Center, Hwy. 72 & 711, P.O. Drawer 2909, 28359, (919) 671-6015, 30' dome theater, observatory, 8" scope. Open Mon.-Fri.

Rocky Mount: Rocky Mount Planetarium, Children's Museum, 1610 Gay St., 27804, (919) 972-1167, 20' dome theater, observatory. Open by reservation.

Salisbury: Margaret C. Woodson Planetarium, 1636 Parkway Circle, 28144, (704) 639-3004, 30' dome theater, exhibits. Open 2nd and 4th Sun. (Sept.-May), by reservation.

Winston-Salem: Natural Science Center/Hanes Planetarium, 1 Museum Dr., 27105, (919) 767-6730, 50' dome theater, observatory. Open in summer.

NORTH DAKOTA

Bismarck: Dakota Astronomical Society, 9115 Baine Dr., 58501, Eric Raveling, (701) 224-8420, 25 members, 12.5" scope. Hotline: 223-2117.

PLACES

Grand Forks: Arthur P. Anderson Atmospherium, University of North Dakota, P.O. Box 8216, University Station, 58202, (701) 777-2791, 40' dome theater, observatory. Open in summer. Program info: 777-3101.

Minot: Minot State University Observatory, 500 University Avenue West, 58701, (701) 857-3071, observatory, 16" SCT. Open daily during fall, spring, and summer, except for some selected Thurs.

Valley City: Valley City State University, 58072, (701) 845-7522, 24' dome theater. Open by reservation. Program info: 845-7452.

OHIO

CLUBS

Barberton: Astronomy Club of Akron, 1591 Eastern Rd., 44203, Rich Ruggles, (216) 753-7769, 60 members, observatory, 12.5" scope.

Chagrin Falls: Chagrin Valley Astronomical Society, P.O. Box 11, 44022, Bob Modic, (216) 731-0522, 25 members, observatory, 16" scope.

Cincinnati: Cincinnati Astronomical Society, 5497 Washigo Dr., 45230.

Cleveland: Cleveland Astronomical Society, Warner and Swasey Observatory, Case Western Reserve Univ., 44106, Dr. Jeanne E. Bishop, (216) 461-1918.

Cleveland: Cuyahoga Astronomical Association, P.O. Box 29089, 44129-0089, Mike Williams, (216) 235-9193, 76 members.

Cleveland: Lewis Astronomy Club, 21000 Brookpark Rd., M.S. 16-1, 44135-3191, Martin Mayer, (216) 433-8451.

Columbus: Columbus Astronomical Society, 5280 Cape Cod Ln., 43235, Tom Burns, (614) 459-7742.

Dayton: Miami Valley Astronomical Society, 2600 DeWeese Parkway, 45414, Ron Whitehead or Wade Allen, (513) 837-4343, 110 members, observatory.

Lima: Lima Astronomical Society, P.O. Box 201, 45802, Eugene McCall, 25 members, observatory, 14" scope.

Lorain: Black River Astronomical Society, 1631 Maple Dr., 44052, Michael Harkey, (216) 288-8556, 55 members, observatory, 13.1" scope.

Mansfield: Richland Astronomical Society, P.O. Box 1118, 44901-9998, Keith Moore, (419) 468-3542, 43 members, observatory, 31" scope. Hotline: 524-6418.

New Philadelphia: Tuscarawas County Amateur Astronomical Society, 1315 E. High Ave., 44663, Sam Krempasky, (216) 339-7335, 10 members, 13.1" scope.

Newton Falls: Mahoning Valley Astronomical Society, 1076 State Rt. 534, 44444, Mark Baker, 46 members, observatory, 16" scope.

Rossford: Northwest Ohio Visual Astronomers, 1018 E. Elmtree Rd., 43460, Frank Myers, (419) 666-8566, 10 members, observatory, 25" scope.

South Point: Ohio Valley Astronomical Society, Route 1, Box 787, 45680, Scott Hogsten, (614) 894-3522, 12 members, 14" scope.

Tiffin: Sandusky Valley Amateur Astronomy Club, 650 S. Washington St., 44883, Thomas Fretz, (419) 448-9377, 22 members, observatory, 12.5" scope.

Troy: Stillwater Stargazers, Brukner Nature Center, 5995 Horseshoe Bend Rd., 45373, Dick Pierce, (513) 773-7256, 20 members.

Westerville: Westerville Astronomy Interest Group, Otterbein College, Physics/Astronomy Dept., 43081, Earl W. Phillips, Jr., (614) 764-0476, 50 members, observatory, 14" scope.

Wilmore: Wilderness Center Astronomy Club, P.O. Box 202, 44689-0202, Dave Gill, (216) 497-9581, 55 members, 16" scope.



fontaine St., 45895, (419) 738-8811, 56' dome theater, observatory, exhibits, tours. Open daily (Mar.-Nov.).

Youngstown: Ward Beecher Planetarium, Youngstown State University, 44555-2001, 40' dome theater, observatory, 14" SCT. Open Mon.-Fri. Program info: (216) 742-3616.

OKLAHOMA

CLUBS

Ardmore: Arbuckle Astronomical Society, 713 Ash N.W., 73401, Steve Girard, (405) 226-0339.

Bartlesville: Bartlesville Astronomical Society, Route 2, Box 3230, 74006, John Grismore, (918) 525-7257, 21 members.

Boise City: Cimarron County Star Gazers, P.O. Box 278, 73933, Jim Rosebery, (405) 544-2222.

Enid: Northwest Oklahoma Astronomy Club, 1719 Pawnee, 73703, Dan Mathews, 55 members.

Oklahoma City: Oklahoma City Astronomy Club, 6616 N. W. 20th, P.O. Box 21221, 73135, Mark Lindsey, 72 members, 12" scope. Hotline: (405) 789-3742.

Purcell: Central Oklahoma Astronomy Club, P.O. Box 628, 73080.

Tulsa: Astronomy Club of Tulsa, 3832 S. Victor Ave., 74105, Newell Pottorf, (918) 742-7577, observatory, 16" scope.

PLACES

Fort Sill: Fort Sill Planetarium, Target Acquisition Department, 73503, (405) 351-6616. Open by reservation.

Oklahoma City: Kirkpatrick Planetarium, Omniplex Science Museum, 2100 N.E. 52nd, 73111, 40' dome theater, observatory, 16" reflector, exhibits, tours. Program info: (405) 424-5545.

OREGON

CLUBS

Bend: Central Oregon Astronomical Society, 669 1/2 NE Lafayette, 97701, Steve Carsey, (503) 387-9058, 50 members, observatory, 15" scope.

Eugene: Eugene Astronomical Society, P.O. Box 70372, 97401, Bruce Sackett, (503) 747-5627, 65 members.

Portland: Rose City Astronomers, P.O. Box 91416,

97291, Chuck Dethloff, (503) 629-2145, 275 members. Hotline: 256-1840.

Roseburg: Umpqua Amateur Astronomers, Umpqua Community College, 3150 W. Military Ave., 97470, Paul Morgan, (503) 673-1081, 16 members.

Veronia: Northwest Astronomy Group, 55371 McDonald Rd., 97064, Sandy Mikalow, (503) 429-2430, observatory, 14" scope.

PLACES

Eugene: Lane ESD Planetarium, 2300 Leo Harris Parkway, 97401, (503) 687-6500 x227, 40' dome theater, observatory, 16" SCT, exhibits. Open Wed.-Sun. Program info: 687-STAR.

Eugene: Pine Mountain Observatory, University of Oregon, Bend-Burns Star Route, 97405, (503) 382-8331, observatory, 32" scope. Open by reservation.

Gresham: Mt. Hood Community College Planetarium, 26000 S.E. Stark St., 97030, (503) 667-7297, 30' dome theater, observatory, 6" solar telescope. Open for public shows on first Fri. and Sat. of each month.

Oregon City: Haggart Observatory, John Inskeep Environmental Learning Center, P.O. Box 5162, 97045, (503) 657-0155, observatory, 24" Newtonian. Open Wed., Fri., and Sat. and by reservation.

Portland: Oregon Museum of Science and Industry, Sky Theater, 1945 S.E. Water Ave., 97214, (503) 797-4000, 52' dome theater, OMNIMAX, exhibits, tours. Program info: 797-4610.

Salem: Chemeketa Community College Planetarium, 4000 Lancaster Dr., N.E., P.O. Box 14007, 97309, (503) 399-5161, 35' dome theater. Open Fri. and Sat.; not open in summer. Program info: 399-5200.

Sunriver: Sunriver Nature Center Observatory, P.O. Box 3533, 97707, observatory, 12.5" reflector, exhibits, tours. Open Tues.-Sat. Program info: (503) 593-4442.

PENNSYLVANIA

CLUBS

Allentown: Lehigh Valley Amateur Astronomical Society, Inc., 620 East Rock Rd., 18103, Gary A. Becker, (610) 282-3583, 150 members, observatory, 20" scope. Hotline: 797-3476.

Beaver: Beaver Valley Astronomy Club, 1335 3rd St., #2, 15009, David Yoder, (412) 728-5255.

Clarks Summit: Lackawanna Astronomical Society, 1112 Fairview Rd., 18411, John D. Sabia, (717) 586-0789, 100 members, observatory, 12.5" scope.

Duncannon: Astronomical Society of Harrisburg, RD 4, Box 4038 Motter Rd., 17020, Calvin Cassel, Jr., (717) 834-9398, 120 members, observatory, 17.5" scope. Hotline: 938-6041.

Haverford: Rittenhouse Astronomical Society, 216 Elbow Ln., 19041-1806, Nancy Blossom, (610) 642-4337, 80 members.

Hazleton: Greater Hazleton Area Astronomical Society, P.O. Box 151, 18201, Scott McAndrews, 30 members.

Kane: Sir Isaac Newton Astronomical Society, P.O. Box 591, 16735, William Kearney, (814) 837-7205, 10 members.

Lansdale: L5 Society of Philadelphia, 1825 Flintlock Circle, 19446, Jay B. Haines, (215) 855-7130.

Lewisburg: Bucknell University Astronomy Club, Dept. Of Physics, Bucknell University, 17837, David Lien, (717) 524-1139, 15 members, observatory, 10" scope.

Oreland: Delaware Valley Amateur Astronomers, 505 Ramsey Road, 19075, Al Lamperti, (215) 836-9266, 187 members.

Philadelphia: Astronomy To Go, 6233 Caster Ave., 19149, Bob Summerfield, (215) 831-0485.

Pittsburgh: Amateur Astronomers Assoc. of Pittsburgh, P.O. Box 314, Glenshaw, 15116, John Holtz, 300 members, observatory, 12.5" scope. Hotline: (412) 224-2510.

University Park: Penn State Astronomy Club, 202 HUB, 16802, Paul Markowski, 45 members, observatory, 16" scope.

Warminster: Bucks-Mont Astronomical Association, 1443 Devon Rd., 18974, Edward Melnick, (215) 443-7929, 60 members.

Warren: Warren City Amateur Astronomers Club, 118 Falconer St., 16365, Tom Traub, (814) 723-9428.

West Leechburg: Kiski Astronomers, 123 Summit Ave., 15656, Robert A. Yajko, 30 members, 17.5" scope. Hotline: (412) 842-8202.

Wyomissing: Berks County Amateur Astronomical Society, P.O. Box 6150, 19610, David Brown, (215) 375-9062, 60 members. Hotline: 376-8801.

York: York County Parks Astronomical Society, 400 Mundis Race Rd., 17402, Jeri Jones, (717) 225-3744, 45 members, observatory, 18" scope.

PLACES

Allentown: Joseph Grady Planetarium, 620 East Rock Rd., 18103, (215) 967-1991, 21' dome theater, observatory, 12" SCT, tours. Open by reservation. Program info: 797-3476.

Altoona: Neil Armstrong Planetarium, Altoona Area School District, 1415 6th Ave., 16602, (814) 946-8315.

Clarion: Clarion University, 335 Peirce Science Center, 16214, 40' dome theater, observatory, planetarium. Program info: (814) 226-1881.

Edinboro: Observatory, Edinboro University, 16444, observatory, 16" SCT, tours. Open by reservation. Program info: (814) 732-2469.

Erie: Erie Historical Museum and Planetarium, 356 West 6th St., 16507, (814) 453-5811. Open Tues.-Sun.

Harrisburg: State Museum of Pennsylvania Planetarium, 3rd and North Streets, Box 1026, 17108-1026, (717) 783-9914, 30' dome theater, exhibits. Open Tues.-Sun. Program info: 787-4978.

Lancaster: North Museum Planetarium, Franklin & Marshall College, P.O. Box 3003, 17604-3003, (717) 291-3941, 40' dome theater, observatory, 16" scope. Open Wed.-Sun. Program info: 291-4315.

Lafayette: Observatory, St. Vincent College, 15650, (412) 539-9761. Open Sun. by reservation.

Lewisburg: Bucknell University Observatory, Dept. of Physics, 17837, (717) 524-1207, observatory, 10" scope. Open by reservation.

Lock Haven: Ulmer Planetarium, Lock Haven University, 17745, (717) 893-2075, 30' dome theater, observatory. Open by reservation.

New Wilmington: Westminster College Planetarium, Hoyt Science Center, 16172, (412) 946-7200, 20' dome theater, observatory, 14" SCT. Open by reservation.

Philadelphia: Fels Planetarium-Franklin Institute Science Museum, 20th and the Ben Franklin Pk., 19103, (215) 448-1293, 65' dome theater, observatory, 24" reflector, OMNIMAX. Open by reservation. Program info: 448-1200.

Philadelphia: University of Pennsylvania Observatory, Astronomy Dept., David Rittenhouse Laboratory, 33rd and Walnut St., 19104, (215) 898-8176. Open Mon. and Thurs. evenings.

Pittsburgh: Allegheny Observatory, University of Pittsburgh, Observatory Station, 15214, (412) 321-2400, observatory, 30" refractor. Open by reservation.

Pittsburgh: Henry Buhl Jr. Planetarium & Observatory, Carnegie Science Center, 1 Allegheny Ave., 15212-5850, (412) 237-3397, 50' dome theater, observatory, 16" reflector, OMNIMAX, exhibits. Open daily. Program info: 237-3400.

Reading: Reading Public Museum & Planetarium, 500 Museum Rd., 19611-1441, (215) 371-5838, 40' dome theater. Open Mon.-Fri. Program info: 371-5854.

Scranton: Everhart Museum Planetarium, Nay Aug Park, 18510, (717) 346-8370. Open Tues.-Fri. by reservation.

Shippensburg: Dibert Planetarium, Shippensburg University, 17257, 30' dome theater. Open during school year. Program info: (717) 532-1491.

Villanova: Villanova University Observatory, Mendel Hall, Villanova University, 19085, (215) 645-4820, observatory, 14" reflector. Open Mon.-Thurs. during school year.

West Chester: West Chester State University Planetarium, Dept. of Geology & Astronomy, Rosedale and South Church Streets, 19383, (215) 436-2721, 33' dome theater, observatory, 12" scope. Open by reservation.

Williamsport: Detwiler Planetarium, Lycoming College, 17701-5192, (717) 321-4284, 30' dome theater. Open by reservation.

PUERTO RICO

San Juan: Sociedad de Astron. de Puerto Rico Inc., P.O. Box 362846, 00936-2846, Luis A. Maura, (809) 765-0889, 130 members.

PLACES

Arecibo: Arecibo Radio Observatory, 00612, (809) 878-2612.

RHODE ISLAND

CLUBS

North Scituate: Skyscrapers Inc., 47 Peep Toad Rd., 02857, Conrad Cardano, (401) 828-0702, observatory, 20" scope.

Providence: Celestial Observers of Rhode Island, P.O. Box 40181, 02940, Ken Conca, (401) 351-5676, 66 members, observatory, 22" scope. Hotline: (508) 252-4065.

PLACES

Charlestown: Frosty Drew Observatory, Ninigret

Park, P.O. Box 160, 02813, observatory, 12.5" reflector, 7" refractor. Open clear Fri.

Middletown: Middletown Planetarium, Gaudet School, Aquidneck Ave., 02840, (401) 846-6395, 30' dome theater, observatory. Open by reservation.

Providence: Cormack Planetarium, Museum of Natural History, Roger Williams Park, 02907-3600, (401) 785-9450 x227, 28' dome theater, observatory, 6" reflector, exhibits, tours. Open daily, except Mon. Program info: 785-9457.

Providence: Ladd Observatory, 210 Doyle Ave., 02906, (401) 863-2314, observatory, 12" refractor. Open Wed. evenings. Program info: 521-5680.

Warwick: Community College of Rhode Island, 400 East Ave., 02886, (401) 825-2178, observatory, 14" SCT. Open by reservation. Program info: 825-2207.

SOUTH CAROLINA

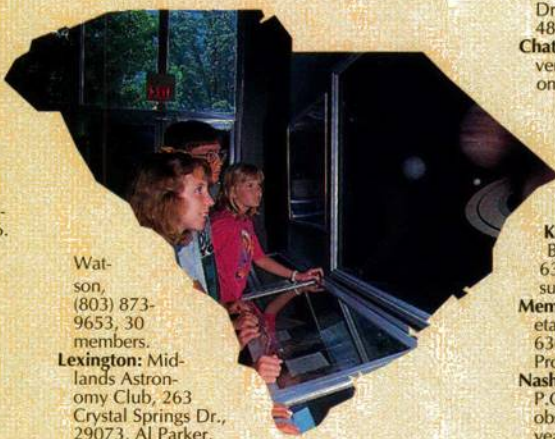
CLUBS

Aiken: Aiken Astronomy Club, USC-Aiken, Building 106, 171 University Parkway, 29801, Richard M. Albert, (803) 663-3105.

Central: Clemson Area Amateur Astronomers, 1550 Old Seneca Rd., 29630-9597, Dixon Lomax, (803) 654-3689, 35 members, observatory, 29" scope.

Greenville: Roper Mountain Astronomers, 504 Roper Mountain Rd., 29615, Doug Gegen, (803) 281-1188, 100 members, observatory, 23" scope. Hotline: 244-7821.

Ladson: Low Country Stargazers, 200 Finch St., 29456, Kirsten



Watson, (803) 873-9653, 30 members.

Lexington: Midlands Astronomy Club, 263 Crystal Springs Dr., 29073, Al Parker, 54 members. Hotline: (803) 755-7195.

Rock Hill: Carolina Skygazers, Museum of York County, 4621 Mt. Gallant Rd., 29732, Barbara Reynolds, (803) 329-2121, 68 members.

PLACES

Columbia: Gibbs Planetarium, 1112 Bull St., 29210, (803) 799-2810, 26' dome theater, exhibits, tours. Program info: 254-STAR.

Columbia: Melton Memorial Observatory, University of South Carolina, Dept. of Physics & Astronomy, 29208, (803) 777-6466, observatory, 16" SCT. Open Mon. and by reservation. Program info: 777-4180.

Florence: Florence Air and Space Museum, U.S. Highway 301, North Airport Entrance Rd., 29503, (803) 665-5118.

Florence: Francis Marion College, Planetarium and Observatory, P.O. Box 100547, 29501-0547, (803) 661-1250, 33' dome theater, observatory, 14" SCT. Open 2nd and 4th Sun.

Greenville: Charles Daniel Observatory, 504 Roper Mountain Rd., 29615, (803) 281-1188, 50' dome theater, observatory, 23" Clark refractor. Open Fri.

Orangeburg: Stanback Museum and Planetarium, P.O. Box 7636, 29117, (803) 536-8711, 40' dome theater, observatory. Not open in summer. Program info: 536-8709.

Rock Hill: Settlemyre Planetarium, Museum of York County, 4621 Mt. Gallant Rd., 29732, (803) 329-2121, 30' dome theater, exhibits, tours. Open daily.

SOUTH DAKOTA

CLUBS

Rapid City: Black Hills Astronomical Society, 4912 Breckenridge Ct., 57702, Michael O'Connor, (605) 342-3793, observatory open to the public, 12.5" scope.

Sioux Falls: Sioux Valley Amateur Astronomers, 500 S. Williams Ave., 57104-3835, Melvin Pine, (605) 334-3398, 25 members.

TENNESSEE

CLUBS

Brentwood: Barnard-Seyfert Astronomical Society, Dyer Observatory, 1000 Oman Dr., 37027, A. Heiser, (615) 373-4897, 78 members, 12" scope. Hotline: 780-3751.

Chattanooga: Barnard Astronomical Society, 838 Belvoir Hills Dr., 37412, F. Randolph Helms, (615) 629-6094, 45 members, observatory, 20.5" scope.

Gallatin: Spyglass Network, 1203 Highway 25, 37066, Gary Likert, (615) 734-4147, 20 members.

Kingsport: Bays Mountain Amateur Astronomers, 853 Bays Mountain Park Rd., 37660, Mike Chesman, 45 members, observatory, 17.5" scope.

Knoxville: Orion Research Forum and Network, P.O. Box 50291, 37950, Bob Miles, (615) 588-3087, 12 members.

Knoxville: Smoky Mountain Astronomical Society, P.O. Box 53265, 37950, Paul Lewis or Barry Cain, (615) 584-7981, 53 members, observatory, 20" scope.

Manchester: Middle Tennessee Astronomical Society, 1305 Sycamore St., 37355-2067, Donald W. Male, (615) 728-7321, 10 members.

Memphis: Memphis Astronomical Society, 1229 Pallwood Rd., 38122, Richard Moore, (901) 682-2003, 55 members.

Memphis: Society of Low Energy Observers, 4277 Park Forest Dr., 38141-7126, Kathy Nix, (901) 366-4201, 31 members.

PLACES

Brentwood: A. J. Dyer Observatory, 1000 Oman Dr., Vanderbilt University, 37027, (615) 373-4897, observatory, 24" reflector. Open Mar.-Nov.

Chattanooga: Clarence T. Jones Observatory, University of Tennessee, Dept. of Physics and Astronomy, 37403, (615) 755-4546, 24' dome theater, observatory, 20.5" reflector. Open Fri.

Kingsport: Bays Mountain Planetarium and Nature Center, 853 Bays Mountain Park Rd., 37660, (615) 229-9447, 40' dome theater, observatory, 8" refractor, exhibits. Open weekends year round, daily in summer.

Knoxville: East Tennessee Discovery Center, P.O. Box 6204, 516 Beaman St., 37914-0204, (615) 637-1192, 30' dome theater, exhibits. Open in summer.

Memphis: Memphis Pink Palace Museum and Planetarium, 3050 Central Ave., 38111, (901) 320-6364, 50' dome theater, observatory, 20" reflector. Program info: 320-6320.

Nashville: Dyer Observatory, Vanderbilt University, P.O. Box 1803, Station B, 37235, (615) 373-4897, observatory, 6" refractor. Open 13-15 times per year.

Nashville: Sudekum Planetarium, Cumberland Science Museum, 800 Fort Negley Blvd., 37203-4899, 40' dome theater, observatory, 10" scope, exhibits. Open Tues.-Sun. (Sept.-May). Program info: (615) 862-5160.

Sewanee: The University of the South Observatory, SPO 1165, 735 University Ave., 37375-1000, (615) 598-1458, observatory, 11" Schmidt-SCT, tours. Open Thurs.

TEXAS

CLUBS

Abilene: Abilene Astronomical Society Inc., 1109 Highland Ave., 79605, George Schroeder, (915) 677-5713.

Amarillo: Amarillo Astronomy Club, 1528 S. Kentucky, 79102, Bob Fowler, (806) 359-8050, 40 members.

Austin: Austin Astronomical Society, P.O. Box 12831, 78711, Larry Kemp, 100 members, observatory, 12.5" scope.

Beaumont: Astronomical Society of Southeast Texas, P.O. Box 7943, 77726-7943, Dave Deming, (409) 745-1366, 40 members.

College Station: Association of Amateur Astronomers, Texas A&M University, Dept. of Physics, 77843-4242, Dan Bruton, (409) 268-7738, 25 members, observatory, 14" scope. Hotline: 845-0536.

Corpus Christi: Corpus Christi Astronomical Society, 3814 Marion St., 78415, Gary Mayer, (512) 852-7643, 10 members.

Dallas: Texas Astronomical Society of Dallas, P.O. Box 25162, 75225, John Wagoner, (214) 422-1886, 300 members.

Ft. Worth: Fort Worth Astronomical Society, P.O. Box 161715, 76161-1715, Jay Hornsby, (817) 292-8527, 110 members, observatory, 18" scope.

Ft. Worth: General Dynamics Astronomy Club, 3400 Bryant-Irvin Rd., 76109, George Parker, (817) 294-9536, 53 members, observatory, 19" scope.

Ft. Worth: Texas Observers, 1501 Montgomery St., 76107, Don Garland, (817) 732-1631.

Georgetown: Williamson County Astronomy Club, 901 S. Church St., 78626, John Upton, (512) 869-4296, 30 members.

Houston: Houston Astronomical Society, P.O. Box 20332, 77225-0332, Scott Mitchell, (713) 461-3020, observatory, 14" scope.

Houston: Houston Space Society, P.O. Box 266151, 77207-6151, Richard Braastad, (713) 520-6924, 50 members.

Houston: Students for the Exploration and Development of Space, P.O. Box 310 CA, University Center, University of Houston, 77204-4792, Alvin Carley, (713) 921-7532, 120 members.

Houston: University Space Society, University of Houston, Box 310 CA, UC, 77204-4792, Alvin Carley, (713) 921-7532, 20 members, 36" scope.

Irving: Sidewalk Astronomers of SASI International, 3808 N. Beltline #119, 75038-5755, Johnathon Wilkendorf, (214) 256-1513, 120 members, observatory, 16" scope. Hotline: 256-1607.

Lake Jackson: Brazosport Astronomical Society, 400 College Dr., 77566, 15 members.

Lubbock: South Plains Astronomy Club, 4803 76th St., 79424-2148, Wayne Lewis, (806) 794-8766, 35 members.

McAllen: Valley Astronomical Society, 7005 North 31st St., 78504.

Midland: West Texas Astronomers, 2801 Metz Dr., 79705, Bruce Barton, Sec., (915) 694-3262, 21 members.

Odessa: Odessa Observers, P.O. Box 301, 79760, F.A. McElvaney.

San Angelo: San Angelo Amateur Astronomy Assoc., P.O. Box 60391, 76906-0391, Mark Sonntag, (915) 942-9000, 30 members.

San Antonio: San Antonio Astronomical Association, 6427 Thoreau's Way, 78239, Rick Garcia, (512) 654-9784.

Sanger: Denton County Astronomical Society, 225 Green Springs Circle, 76266, John Love, (817) 458-7479.

Stafford: Fort Bend Astronomy Club, P.O. Box 942, 77497-0942, Dennis Zwicky or Keith Hammons, 135 members, observatory, 18" scope. Hotline: (713) 980-7827.

Texas City: College of the Mainland Astronomy Club, 1200 Auburn Rd., 77591, John L. Hubisz, (409) 938-4098, 43 members.

Tyler: Astronomical Society of East Texas, Hudnall Planetarium, P.O. Box 9020, 75711, Mike Mikule, (214) 561-3710, observatory, 10" scope.

Victoria: Crossroads Astronomy Club, 233 Spur Dr., 77904, Derek Newton, (512) 573-2391.

Waco: Waco Major Astronomy Society, Baylor University, Box 7316, 76798.

Wichita Falls: Wichita Falls Astronomy Club, 2020 Santa Fe #10, 76309, Sandra Camp, (817) 723-0205, 20 members.

PLACES

Amarillo: Don Harrington Discovery Center, 1200 Streit Dr., 79106, dome theater, observatory, heliostat, Cinema 360°, exhibits. Open Tues.-Sun. Program info: (806) 355-9548 x4.

Dallas: Richland College Planetarium, 12800 Abrams Rd., 75243, (214) 238-6038, 40' dome theater. Open 2nd, 3rd, and 4th Sat. Program info: 238-6013.

Dallas: St. Mark's School of Texas Planetarium, 10600 Preston Rd., 75230, (214) 363-6491, 30' dome theater, observatory, 16" Maksutov. Open by reservation.

Dallas: The Science Place Planetarium, P.O. Box 151469, 75315-1469, (214) 428-8351, 24' dome theater, observatory. Open in summer.

El Paso: El Paso Planetarium, 6531 Boeing Dr., 79925, (915) 779-4316, 40' dome theater, observatory, exhibits. Open Mon.-Fri. Program info: 779-4317.

El Paso: Insights, El Paso Science Center, 505 N. Santa Fe St., 79901, (915) 542-2990.

Ft. Davis: University of Texas-McDonald Observatory, Hwy 118N, P.O. Box 1337, 79734-1337, (915) 426-3640, observatory, 24" scope, exhibits, tours.

Ft. Worth: Noble Planetarium, 1501 Montgomery St., 76107, (817) 732-1631, 30' dome theater, observatory. Open in summer.

Houston: Houston Museum of Natural Science, Burke Baker Planetarium, One Hermann Circle Dr., 77030, (713) 639-4632, 50' dome theater, observatory, 36" reflector. Open in summer. Program info: 639-4600.

Houston: Lyndon B. Johnson Space Center, 2101 NASA Road One, 77058, (713) 483-4321. Open daily.

Houston: Space Center Houston, 1601 NASA Road One, 77058, (713) 244-2140, exhibits, tours. Program info: (800) 972-0369.

Killeen: Central Texas College Planetarium, P.O. Box 1800, 76540, (817) 526-1288, 24' dome theater, observatory, 8" SCT, tours. Open by reservation. Program info: 698-2419.

Lake Jackson: Brazosport Nature Center Planetarium, 400 College Dr., 77566, 30' dome theater. Open Tues. Program info: (409) 265-3376.

Lubbock: Texas Tech Moody Planetarium, Museum of Texas Tech, University, 4th and Indiana Ave., Box 43191, 79409-3191, (806) 742-2432, 30' dome theater, observatory. Open in summer.

Midland: Marian Blakemore Planetarium, Museum of the Southwest, 1705 W. Missouri, 79701-6516, (915) 683-2882, 40' dome theater, observatory. Open Sun. and Tues.

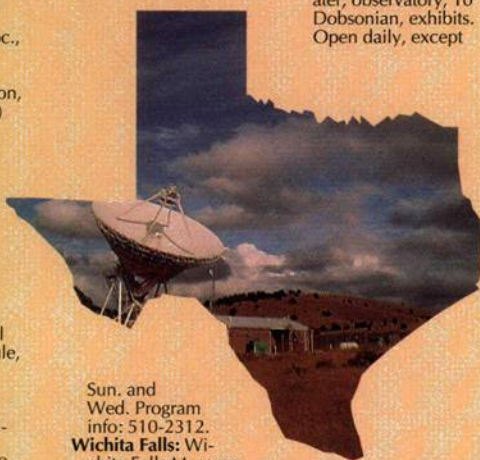
Nacogdoches: Stephen Austin State University Planetarium, Physics & Astronomy Dept., P.O. Box 13044 SFA Station, 75962, (409) 568-3001, 30' dome theater, observatory, SCT, tours. Open by reservation. Program info: 568-3009.

Odessa: Odessa Meteor Crater, 620 N. Grant, Suite 1204, 79761, (915) 332-1666. Open daily.

San Angelo: Angelo State University Planetarium, Physics Department, 76909, (915) 942-2136, 50' dome theater, observatory, 8" SCT, exhibits. Program info: 942-2188.

San Antonio: San Antonio College Planetarium, 1300 San Pedro Ave., 78212, (210) 733-2910, 30' dome theater, observatory, 14" SCT. Open Sept.-June. Program info: 733-2911.

Tyler: Hudnall Planetarium, Tyler Junior College, E. 5th Ave., 75711, (903) 510-2578, 30' dome theater, observatory, 10" Dobsonian, exhibits. Open daily, except



Sun. and Wed. Program info: 510-2312.

Wichita Falls: Wichita Falls Museum & Art Center Planetarium, 2 Eureka Circle, 76308, (817) 692-0923, 26' dome theater, observatory. Open Sat. and Sun.

UTAH

Cedar City: Southern Utah Astronomy Group, 147 South 300 East, 84720, Brent Sorensen, (801) 586-2759, observatory, 14" scope.

Roy: Ogden Astronomical Society, 2336 West 5650 South, 84067, Robert Tillotson, (801) 773-8106, 32 members.

Salt Lake City: Salt Lake City Astronomical Society, Hansen Planetarium, 15 South State St., 84111-1590, Sue Chamberlin, (801) 254-8418, 235 members, observatory, 16" scope. Hotline: 532-STAR.

PLACES

Ogden: Layton P. Ott Planetarium, Weber State University, 84408-2508, (801) 626-7907, 30' dome theater, observatory, 18" scope, planetarium. Open Wed. and by reservation. Program info: 626-6855.

Provo: Sarah B. Summerhays Planetarium, Brigham Young University, 492 ESC, 84602, (801) 378-2805, 24' dome theater, observatory, 14" scope. Open Fri. and by reservation. Program info: 378-5396.

Salt Lake City: Hansen Planetarium, 15 South State St., 84111, (801) 538-2104, 50' dome theater, observatory, exhibits, tours. Program info: 532-STAR.

VERMONT

Williston: Vermont Astronomical Society, P.O. Box 782, 05495, Frank J. Pakulski, (802) 985-3269, 55 members, observatory, 16" scope.

PLACES

Norwich: Montshire Museum of Science, P.O. Box 770, 05055, (802) 649-2200. Open last Sat. of month during school.

Williston: Green Mountain Observatory, P.O. Box

782, 05495, (802) 985-3269, observatory, 16" scope. Open by reservation.

VIRGINIA

CLUBS

Bassett: Piedmont Astronomy Club, P.O. Box 865, 24055, James I. Marshall.

Blacksburg: Astronomy Club of Virginia Tech, Virginia Polytechnic Institute, 216 Robeson Hall, 24061, Chadd Smith, (703) 231-5719, observatory, 14" scope, 40 members. Hotline: 231-4800 ext. 912.

Bristol: Bristol Astronomy Club, 4559 Reedy Creek Rd., 24201, Ken Childress, (703) 466-8404, 22 members, observatory, 12.5" scope.

Charlottesville: Society for Scientific Exploration, P.O. Box 3818, 22903, L.W. Frederick, (804) 924-4905.

Chesapeake: Back Bay Amateur Astronomers, 2808 Flag Rd., 23323-2102, Glendon L. Howell, (804) 485-4242, 20 members.

Fairfax: Nova Space Society, 4344 Mt. Carriage Ln., 22033, Jim Myska, (703) 803-7961.

Fredericksburg: Triangulum Astronomical Society, P.O. Box 7464, 22404, Gary Goodman, (703) 775-3260, 24 members.

Hampton: Skywatchers Astronomy Club, 109 Mill Point Dr., 23669-3534, Marilyn E. Ogburn, 20 members, observatory, 16" scope.

Harrisonburg: Shenandoah Valley Astronomy Club, James Madison University, Dept. of Physics, 22801, Henry W. Leap, (703) 568-6109.

Lynchburg: Lynchburg Astronomy Club, 4648 Locksview Rd., 24503, Allen Majewski, (804) 384-5616.

Middletown: Shenandoah Astronomical Society, P.O. Box 47, Lord Fairfax Community College, 22645, Bill Warren, (703) 459-3510, 40 members, observatory, 8" scope.

Midlothian: Richmond Astronomical Society, 2101 Leovey Ln., 23113, Norm G. Guenther, (804) 794-6413, 50 members, observatory, 13" scope.

Nathalie: Halifax Skywatchers, P.O. Box 22, 24577-0022, Joe Lightcap, (804) 349-3700, observatory, 13" scope.

Portsmouth: Astronomical Society of Tidewater, 2216 Country St., 23704, Leonard Scarr, (804) 484-6152, observatory, 10" scope.

Portsmouth: Tidewater Community College Astronomical Society, Physics Department, State Route 135, 27303, Aubrey Hartman, (804) 488-4354, 50 members, observatory, 14" scope.

Roanoke: Roanoke Valley Astronomical Society, 2607 Oregonian Ave., SW, 24015, Frank Baratta, (703) 774-5651, 75 members.

Verona: Stokesville Astronomy Group, P.O. Box 145, 24482, Jack Wine, (703) 248-0981.

Vienna: Northern Virginia Astronomy Club, 2520 Rocky Branch Rd., 22181, Marta Krause, (703) 281-9049, 150 members. Hotline: 256-8359.

Virginia Beach: Tidewater Amateur Telescope Makers, 677 Charlecote Dr., 23464, Don Wright, (804) 424-9430.

PLACES

Ashland: Keeble Observatory, Randolph-Macon College, 23005, (804) 752-7344, observatory, 12" reflector. Open by reservation. Program info: 798-8372 x578.

Charlottesville: Leander McCormick Observatory, University of Virginia, P.O. Box 3818, 22903-0818, (804) 924-7494, observatory, 26" scope. Open 1st and 3rd Fri.

Chesapeake: Chesapeake Planetarium, 300 Cedar Rd., 23320, 30' dome theater, observatory, 14" SCT, exhibits, tours. Open Mon.-Fri. Program info: (804) 547-0153.

Falls Church: Arlington Planetarium, 3011 Meeting St., 22207, (703) 358-6017, 30' dome theater, observatory, 10" reflector. Open by reservation. Program info: 358-6070.

Hampton: NASA Langley Research Center, Mail Stop 480, 23665, (804) 864-6000. Open daily and by reservation.

Harrisonburg: John C. Wells Planetarium, James Madison University, Miller Hall, 22807, (703) 568-3845, 30' dome theater, observatory. Open Thurs. Program info: 568-STAR.

Harrisonburg: M.T. Brackbill Planetarium, Eastern Mennonite College, 22801, (703) 432-4400, 30' dome theater, observatory, 8" scope. Open by reservation; not open in summer.

Mt. Solon: Stokesville Observatory and Museum, P.O. Box 125, 22843, (800) 626-3948, 16' dome theater, observatory, 14" SCT. Open Fri.-Sat. (May-Nov.) and by reservation.

Newport News: Virginia Living Museum Planetarium, 524 J. Clyde Morris Blvd., 23601, (804) 595-1900 x31, 30' dome theater, observatory, 14" SCT, exhibits, tours. Open daily.

Richmond: Ethyl Universe Planetarium and Space

Theater, 2500 West Broad St., 23220, (804) 367-0211, 76' dome theater, OMNIMAX, exhibits. Program info: 367-0000.

Roonoke: Science Museum of Western

Virginia/Hopkins Planetarium, Center in the Square, One Market Square, 24011, 40' dome theater, observatory, 17" reflector, Cinema 360°. Program info: (703) 342-5710.

Virginia Beach: Virginia Beach City Public Schools Planetarium, Plaza Middle School, 3080 South Lynnhaven Rd., 23452, (804) 431-4067, 40' dome theater, observatory, 8" reflector, exhibits. Open daily and by reservation.

Wallops Island: NASA Visitor Center, Wallops Flight Facility, VA Route 175, 23337, (804) 824-2297, exhibits, tours. Open daily, except Thurs.-Mon. (Sept.-June).

VIRGIN ISLANDS

CLUBS

St. Thomas: Virgin Islands Stargazers, Flagship, 5100 Long Bay, 00802, Jeannie Kuich, (809) 774-5630, 22 members, observatory, 15.5" scope.

WASHINGTON

CLUBS

Bellevue: Eastside Astronomical Society, The Friends of the Planetarium, P.O. Box 7482, 98008-1482, Judy Mason, (206) 745-4077, 135 members. Hotline: 746-3485.

Bellingham: Whatcom Assoc. of Celestial Observers, 3700 Taylor Ave., 98226, Tom Masterson, (206) 734-5821.

Centralia: Southwest Washington Astronomical Society, 2421 Leisure Ln., 98531, Carl M. Newton, (206) 736-6144, 20 members, observatory, 17" scope.

Everett: Everett Astronomical Society, P.O. Box 8012, 98201, Bill O'Neil or Chris Ferrier, (206) 337-6873, 40 members, 10" scope.

Keyport: Olympic Astronomical Society, P.O. Box 458, 98345, James Sykes, (206) 698-0381.

Puyallup: Tacoma Astronomical Society, 6103-132 St. East, 98373, Keith McGowan, (206) 841-1126, observatory, 15" scope.

Richland: Tri-City Astronomy Club, P.O. Box 651, 99352, Barbara Rittmann, (509) 783-1845, 51 members.

Seattle: Boeing Employees' Astronomical Society, Boeing Support Services, P.O. Box 3707, Mail Stop 4H-58, 98124-2207, Carl F. Brenne, 100 members.

Seattle: Seattle Astronomical Society, P.O. Box 31746, 98103, Heidi Sewall, 220 members. Hotline: (206) 523-ASTR.

Spokane: Spokane Astronomical Society, P.O. Box 8114, 99203-8114, (509) 466-1404, 150 members. Hotline: 448-7376.

Yakima: Yakima Valley Astronomy Club, 1108 S. 7th Ave., 98902, William Knight, (509) 457-6410, 22 members.

PLACES

Bellevue: Bellevue Community College Planetarium, 3000 Landerholm Circle, 98007, (206) 641-2321. Open Mon.-Fri. by reservation.

Bellingham: Western Washington University Planetarium, Physics Department, 98225, (206) 650-3820, 24' dome theater, observatory, 8" scope. Open by reservation.

Goldendale: Goldendale Observatory, 1602 Observatory Dr., 98620-3315, observatory, 24.5" SCT, tours, exhibits. Open daily, except Mon. and Thurs. Program info: (509) 773-3141.

Pullman: Planetarium, Washington State University, Dept. of Physics, 99163-3113, (509) 335-8518, 24' dome theater, observatory, 12" refractor. Open by reservation.

Puyallup: Pettinger-Guiley Observatory, 6103-132nd Street East, 98373, (206) 531-1171, 22' dome theater, observatory, 15" refractor. Open twice each month. Program info: 537-2802.

Seattle: Willard W. Smith Planetarium, Pacific Science Center, 200 Second Ave., N., 98109, (206) 443-2001, 27' dome theater, IMAX. Open daily, except Thanksgiving. Program info: 443-2920.

WEST VIRGINIA

CLUBS

Charleston: Kanawha Valley Astronomical Society, c/o Sunrise Children's Museum, 746 Myrtle Rd., 25314, Rich Ireland, (304) 344-9620, 35 members, observatory, 12.5" scope.

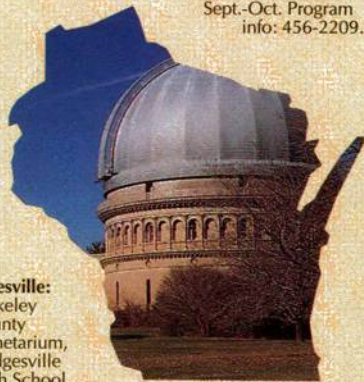
Tridelpia: N.O.V.A.E., Box 436, Chapel Hill, 26059, (304) 547-5578.

PLACES

Charleston: Sunrise Planetarium, 746 Myrtle Rd., 25314, (304) 344-8035, 24' dome theater, observatory, 10" SCT. Open 1st and 3rd Sat. and 2nd and 4th Fri.

Elkins: Davis and Elkins College, 100 Campus Dr., 26241, (304) 636-1900, 25' dome theater. Open by reservation. Program info: 636-1900 x309.

Green Bank: National Radio Astronomy Observatory, P.O. Box 2, 24922, (304) 456-2011, exhibits, tours. Open daily in summer, weekends Sept.-Oct. Program info: 456-2209.



Hedgesville:

Berkeley County Planetarium, Hedgesville High School, RR 1-Box 89, 25427, (304) 754-3354, 20' dome theater, observatory, 8" SCT. Open by reservation.

Parkersburg: Dwight O. Conner Planetarium, 2101 Dudley Ave., Parkersburg High School, 26101, (304) 420-9595 x57, 27' dome theater. Open by reservation.

Wheeling: Wheeling Park Commission, Oglebay Resort and Conference Center, 26003, (304) 243-4034, 40' dome theater, observatory, 4" refractor, Cinema 360°, exhibits.

WISCONSIN

CLUBS

Beloit: Rock Valley Astronomers, 2220 E. Ridge Rd., 53511, Carl Balke, (608) 362-0432, 20 members.

Fall Creek: Chippewa Valley Astronomical Society, Hobbs Observatory, Route 2, Box 94, 54742, Bob Elliott, (715) 877-2657, 16 members, observatory, 24" scope. Hotline: 877-2787.

Fredonia: Northern Cross Science Foundation, N6286 Cedar Valley Rd., 53021, Justin Modiza, (414) 692-2502, observatory, 17.5" scope.

Green Bay: Neville Public Museum Astronomical Society, 210 Museum Place, 54302, Ron Parmentier or Don DeWitt, (414) 468-8945, 55 members, observatory, 30" scope.

La Crosse: La Crosse Area Astronomical Society, P.O. Box 2041, 54602, Robert Allen, (608) 785-8669, 30 members, 13" scope.

Milwaukee: Milwaukee Astronomical Society, Daniel Koehler, (414) 542-9071, 325 members, observatory, 25.7" scope.

Milwaukee: Wehr Astronomical Society, 9701 West

College Ave., Franklin, 53132, Karen Kerans, (414) 425-8550, 50 members, observatory, 12" scope.

Oshkosh: Northeast Wisconsin Stargazers, 1815 Kienast Ave., 54901, 60 members.

Racine: Racine Astronomical Society, P.O. Box 085694, 53408, Don Klem, (414) 878-2774, 65 members, observatory, 16" scope.

Sheboygan Falls: Sheboygan Astronomical Society, 313 Main St., 53085, Kurt Peterson, (414) 467-2257, 14 members, observatory, 8" scope.

Waunakee: Madison Astronomical Society, 404 Prospect Rd., 53597, Bob Manske, 110 members, observatory, 17.5" scope.

PLACES

Eau Claire: L.E. Phillips Planetarium, University of Wisconsin-Eau Claire, 54702-4004, (715) 836-5731, 24' dome theater, observatory, planetarium. Open by reservation. Program info: 836-3148.

Fall Creek: Hobbs Observatory, Beaver Creek Reserve, Route 2, Box 94, 54742, (715) 877-2212, observatory, 24" reflector. Open clear Sat. (May-Oct.). Program info: 877-2787.

La Crosse: Planetarium, University of Wisconsin at La Crosse, Cowley Hall, 54601, 24' dome theater, observatory, 13" reflector, tours. Open daily Sept.-May. Program info: (608) 785-8669.

Madison: University of Wisconsin-Madison, 475 N. Charter St., 53534 Sterling Hall, 53706, (608) 262-3071, observatory, 15.6" refractor. Open daily, except 1st and 3rd Wed. Program info: 262-9274.

Madison: UW Space Place, 1605 S. Park St., 53715, (608) 262-4779.

Menasha: UW Fox Valley Planetarium, University of Wisconsin-Fox Valley, 1478 Midway Rd., 54952-8002, (414) 832-2600, 25' dome theater, observatory, 10" reflector, exhibits, tours. Open daily by reservation. Program info: 832-2848.

Milwaukee: Manfred Olson Planetarium, University of Wisconsin at Milwaukee, 1900 East Kenwood, 53201-0413, (414) 229-42321, 30' dome theater. Open Fri. during school year and by reservation.

Stevens Point: University of Wisconsin-Stevens Point, Dept. of Physics & Astronomy, 740 Reserve St., 54481, (715) 346-2208, 25' dome theater, observatory, 16" SCT. Open by reservation.

Waukesha: Charles Z. Horvitz Planetarium, 222 Maple Ave., 53186, (414) 521-8841, 20' dome theater, exhibits, tours. Open during school year by reservation.

Williams Bay: Yerkes Observatory, 373 W. Geneva St., P.O. Box 258, 53191-0258, (414) 245-5555, observatory, 40" scope. Open Sat. throughout the year.

WYOMING

CLUBS

Casper: Central Wyoming Astronomical Society, 904 North Poplar St., 82601, Mark Hladik, (307) 577-0310.

Cheyenne: Cheyenne Astronomical Society, 6614 N. College #G, 82009, Martin D. Curran, (307) 635-5944, 80 members. Hotline: 635-5944.

PLACES

Casper: Casper Planetarium, 904 North Poplar St., 82601, 30' dome theater, observatory, refractor and reflector, exhibits. Open Aug.-May. Program info: (307) 577-0310.

Laramie: University of Wyoming Planetarium, Dept. of Physics and Astronomy, Box 3905, 82071, (307) 766-6150, 30' dome theater, observatory, 16" SCT. Open Fri. during school year.

Laramie: Wyoming Infrared Observatory, University of Wyoming, University Station, Box 3905, 82071, (307) 766-6150.

NATIONAL ORGANIZATIONS

Amateur Satellite Observers, HCR 65, Box 261-B, Kingston, AR 72742, Jim Hale.

American Association of Variable Star Observers, 25 Birch St., Cambridge, MA 02138, Janet Mattei, (617) 354-0484, 1,100 members.

American Astronomical Society, 2000 Florida Ave. NW, Suite 300, Washington DC, 20009, Peter B. Boyce, (202) 328-2010.

American Lunar Society, P.O. Box 209, East Pitts-

burgh, PA 15112, David Darling (412) 837-6054, 87 members, observatory, 7" refractor.

American Meteor Society, Dept. of Physics-Astronomy, SUNY-Geneseo, Geneseo, NY 14454, David Meisel, (716) 245-5282, 100 members. E-mail: meisel@geneseo (Bitnet).

Antique Telescope Society, 30 Green Valley Rd., Wallingford, PA 19086, (610) 521-8126. Program info: 566-2227.

Association des Groupes d'Astronomes Amateurs, 4545 Pierre-de-Coubertin, C.P. 1000, Succ. M, Montréal, Québec, Canada H1V 3R2, Jean-Marc Richard, (514) 252-3038. Umbrella organization of 30 astronomy clubs in Québec with total membership of 600.

Association of Lunar and Planetary Observers, P.O. Box 209, East Pittsburgh, PA 15112, David Darling, (412) 837-6054, 87 members.

Astronomical League, Science Service Building, 1719 North Street NW, Washington, DC, 12,000 members.

Astronomical Society of the Pacific, 390 Ashton Ave., San Francisco, CA 94112, Robert Havlen, (415) 337-1100, 6,500 members. National organization of professional and amateur astronomers. Annual conference co-sponsored by *ASTRONOMY* magazine.

Astronomy Day Headquarters, Chaffee Planetarium, 54 Jefferson SE, Grand Rapids, MI 49503, Gary Tomlinson, (616) 784-9518, Coordinates National Astronomy Day. Extensive handbook available to assist clubs.

Earthwatch, Box 403, Watertown, MA 02272, Blue Magruder, (617) 926-8200, 60,000 members. Sponsors scientific field research worldwide.

Experimental Technologies Corporation, P.O. Box 274, North Kingstown, RI 02852, Edward Jarbeau, (401) 295-7443. Sponsors educational programs encouraging college students to pursue careers in astronomy-related fields.

Group 70/Large Amateur Telescope Project, 2331 American Ave., Hayward, CA 94545, Denny Medlock, (510) 278-6563, 150 members.

International Amateur-Professional Photoelectric Photometry, Dyer Observatory, 1000 Oman Drive, Brentwood, TN 37027, Douglas S. Hall, (615) 373-4897, 750 members.

International Dark-Sky Association, 3545 N. Stewart, Tucson, AZ 85716, David Crawford, 1,200

members. Promotes awareness of light-pollution problems and its solutions. Literature available.

International Meteor Organization (North America), 181 Sifton Ave., Fort McMurray, Alberta, Canada T9H 4V7, Peter Brown, (403) 743-8625, 600 members worldwide. Coordinates reports from meteor observers. Publishes bimonthly journal.

International Occultation Timing Association, 2760 SW Jewell Ave., Topeka, KS 66611-1614, Craig or Terri McManus, (913) 232-3693, 300 members.

International Planetarium Society, Salt Lake City Astronomical Society, Hansen Planetarium, 15 S. State St., Salt Lake City, UT 84111, (801) 531-4952, 190 members, observatory with 16" scope. Public viewing nights. Hotline: (801) 532-STAR.

Meteoritical Society, The, Dept. of Geological Sciences, Univ. of Tennessee, Knoxville, TN 37996, 850 members.

National Deep-Sky Observers Society, 1607 Washington Blvd., Louisville, KY 40242-3539, Alan Goldstein, (502) 426-4399, 75 members.

National Space Society, 922 Pennsylvania Ave. SE, Washington, DC 20003, Aleta Jackson, (202) 543-1900.

Planetarium Society, The, 65 N. Catalina Ave., Pasadena, CA 91106, Susan Lendroth, (818) 793-5100, 125,000 members.

Publiccom Sky Survey and Nova Patrol, 1940 Cot-

ner Ave., Los Angeles, CA 90025, Ben Mayer, (310) 472-8853, 500 members.

Royal Astronomical Society of Canada, 136 Dupont Street, Toronto, Ontario, Canada M5R 1V2, (416) 924-7973. Founded 1890, 3,200 members. Local centres across Canada. E-mail: asc@vela.astro.utoronto.ca (Internet).

Small Scope Observers Association, 4 Kingfisher Place, Audubon Park, NJ 08106, Robert Brown, (609) 547-9487, 116 members.

Society of Amateur Radio Astronomers, 247 North Linden St., Massapequa, NY 11758, Vincent Caracci, (516) 798-8459, 280 members. Annual convention in June, Green Bank, W.V.

Spaceweek National Headquarters, 1110 NASA Road 1, Suite 100, Houston, TX 77058, Dennis Stone.

Sunsearch Supernova Patrol, 14400 Kolin Ave., Midlothian, IL 60445, Steve H. Lucas, (708) 396-1499, 25 members.

Webb Society (North America), 1440 S. Marmora Ave., Tucson, AZ 85713-1015, Ronald J. Morales, (602) 628-1077, 300 members. Organization of deep-sky observers. Call 4 to 7 p.m. or on Sundays for information.

Western Amateur Astronomers, 163 Starlight Crest Drive, La Canada, CA 91011.

World Space Foundation, P.O. Box Y, 91030-1000, Jack Child, (818) 357-2878.

Young Astronaut Council, 1308 19th St. N.W., Suite 800, 20036, T. Wendell Butler, (202) 682-1984.

STAR PARTIES

Clubs in most areas host yearly, monthly, even weekly star parties. While many of these parties draw small groups of local observers, others entice thousands to attend. What follows is a list of annual parties for 1995. The entries are given by month and indicate the party's location and sponsor. Each contains the most current information available to *ASTRONOMY* before going to press. For updates, be sure to contact the clubs prior to your attending and refer to *ASTRONOMY*'s monthly "Meetings and Events" column.

FEBRUARY

California
School District Wide Star Party, Apple Valley. Sponsored by High Desert Astronomical Society. Contact Club Secretary, P.O. Box 3968, Apple Valley, 92307, (619) 242-3514.

Florida

Winter Star Party, Key West. Sponsored by the Southern Cross Astronomical Society, Inc. Contact bob or Sharon Grant, 5401 S.W. 110 Ave., Miami, 33165, (305) 595-8778.

Québec

Camp Valetre, Waterville. Sponsored by Club des Astronomes Amateurs de Sherbrooke. Contact Iann St-Pierre, 2900 Mesy #41, Sherbrooke, J1L 1A5, (819) 566-8613.

MARCH

North Carolina

Piedmont Star Party, Hagan Stone Park, Greensboro. Sponsored by Greensboro Astronomy Club. Contact Donald Talbert, Natural Science Center, 4301 Lawndale Dr., Greensboro, 27408, (910) 288-3769.

South Carolina

Gathering at the Equinox, National Park, Rock Hill. Sponsored by Carolina Skygazers. Contact Barbara Reynolds, 4621 Mt. Gallant Rd., Rock Hill, 29715.

Washington

Messier Marathon, Spokane. Sponsored by Spokane Astronomical Society. Contact Brad Snowder, S. 4408 Regal, Spokane, 99223, (509) 448-7376.

Wisconsin

Antique Telescopes of Wisconsin, Wehr Nature Center, Franklin. Sponsored by Wehr Astronomical Society. Contact Karen Kerans, 9701 W. College Ave., Franklin, 53132, (414) 425-8550.

Wisconsin

Messier Marathon, Modine-Renstrad Observatory, Yonville. Sponsored by Racine Astronomical Society. Contact Don Klem, P.O. Box 085694, Racine, 53408, (414) 878-2774.

APRIL

British Columbia

Victoria Hobby Show, Victoria. Sponsored by RASC - Victoria Centre. Contact Bill Almond, 354 Benhomer Drive, Victoria, V9C 2C6, (604) 385-4302.

California

Bay-Area Astronomical Auction, Mougé (City) Park, San Jose. Sponsored by San Jose Astronomical Association. Contact Jim Van Nuland, 3509 Calico Ave., San Jose, 95124, (408) 559-1221.

Illinois

Spring Skywatch Star Party, Lake County Museum, Wauconda. Sponsored by Lake County Astronomical Society. Contact Jack Kramer, 603 Dawes St., Libertyville, 60048, (312) 230-3852.

Iowa

Astronomical League North Central Regional Convention, Burlington. Sponsored by Southeastern Iowa Astronomy Club. Contact Marion Bachtell, 1901 S. 10th St., Burlington, 52601, (319) 753-1442.

Maryland

Telescope Fair & Star Party, Owens Science Center, Greenbelt. Sponsored by Goddard Astronomy Club. Contact G.W. Gliba, Code 668.1 GSFC, Greenbelt, 20771, (301) 345-4760.

Mississippi

Mid South Star Gaze, Rainwater Observatory, French Camp. Sponsored by Rainwater Astronomers Association. Contact James G. Hill, 1 Fine Pl., French Camp Academy, French Camp, 39745, (601) 547-6865.

New York

Northeast Astronomy Forum & Telescope Show, Holiday Inn, Suffern. Sponsored by Rockland Astronomy Club. Contact Donald Urban, 73 Haring St., Closter, 07624, (914) 786-7730.

MAY

Arizona

Arizona Star Party. Contact Leon Knott, 1021 S. Revere, Mesa, 85202, (602) 461-1758.

California

Astrocamping Weekend, Lake San Antonio County Park, Bradley. Sponsored by Santa Cruz Astronomy Club. Contact Paul Preto, L-2 Santa Carlos Ln., Santa Cruz, 95065, (408) 335-2423.

Minnesota

Roosevelt Annual School Star Party, Willmar. Sponsored by Willmar Area Astronomy Club. Contact Patrick J. Thibault or Randy Wehler, 622 9th Street SW, Willmar, 56201.

New York

Annual Convention of Northeast Region Astronomical League, Schenectady. Sponsored by Albany Area Amateur Astronomers, Inc. Contact Bob Mulford, 1529 Valencia Rd., Schenectady, 12309, (518) 374-8744.

Michigan

Southeast Michigan Star Party, Fish Lake, Lapeer. Sponsored by EMU Astronomy Club. Contact Norbert Vance, 303 Strong Hall, Ypsilanti, 48197, (313) 487-4144.

California

Riverside Telescope Makers Conference, Camp Oakes, Big Bear. Sponsored by Riverside Telescope Makers Conference, Inc. Contact Robert Stephens, 9045 Haven Ave., Suite 109, Rancho Cucamonga, 91730.

Idaho

Public Star Party and Campout, Craters of the Moon National Monument, Near Arco. Sponsored by Idaho Falls Astronomical Society. Contact Jim Ruggiero, 1710 Claremont Ln., Idaho Falls, 83404, (208) 524-6317.

Texas

Texas Star Party, Prude Ranch, Fort Davis. Sponsored by the Texas Astronomical Society of Dallas. Contact TSP Registrar, 1326 Mistywood, Allen, 75002, (214) 727-8733.

JUNE

Arizona

Astrophotography Festival, Red Rock State Park, Sedona. Sponsored by Verde Valley Astronomy Club. Contact Russell Nidey, 1101 Zalesky Rd., Cottonwood, 86326, (602) 634-7332.

Arizona

Grand Canyon Star Party, Grand Canyon National Park-Yavapai Point. Sponsored by Tucson Amateur Astronomy Association. Contact TAAA, P.O. Box 41254, Tucson, 85717.

Maryland

Universe 95. Sponsored by Astronomical Society of the Pacific and *ASTRONOMY* magazine. Contact Robert Havlen, 390 Ashton Ave., San Francisco, CA 94112, (415) 337-1100.

New Jersey

Jersey Star Quest, 4-H Camp near High Point. Sponsored by Amateur Astronomers Association of Princeton. Contact Greg Mauro, P.O. Box 2017, Princeton, 08540, (609) 585-9465.

Pennsylvania

Mason-Dixon Star Party, Glen Rock. Sponsored by York County Parks Astronomical Society. Contact Todd Ullery, R.D. #1, Box 5AA, Glen Rock, PA 17327, (717) 235-1153.

Pennsylvania

Astroblast, Oil Region Observatory, Oil City. Sponsored by Marshal Martz Memorial Astronomical Association. Contact Tom Bemus, Rd.

#3 Box 161A, Bemus Point, 14712, (716) 386-4566.

Québec

Star Party, Saint-Louis-De-France. Sponsored by Astronomy Club of Saint-Louis-De-France. Contact M. Gabriel Forest, 850 rue Larkin, Saint-Louis-De-France, G8T 7V8, (418) 839-7475.

South Carolina

A.L.P.O. Convention. Sponsored by Association of Lunar and Planetary Observers. Contact: Dr. John E. Westfall, P.O. Box 16131, San Francisco, CA 94116.

JULY

California

Star-B-Que, Sugarloaf State Park, Santa Rosa. Sponsored by Sonoma County Astronomical Society. Contact Ed and Cindy Megill, P.O. Box 183, Santa Rosa, 95402, (707) 795-7829.

Colorado

Star Stare, Badger Flats, Colorado Springs. Sponsored by Colorado Springs Astronomical Society. Contact Mike Frazier, P.O. Box 62022, Colorado Springs, 80962, (719) 591-9349.

Massachusetts

Summer Star Party and Camping Vacation, Shady Pines Camp Ground, Savoy. Sponsored by Rockford Astronomy Club. Contact Donald Urban, 73 Haring St., Closter, NJ 07624, (914) 786-7730.

Missouri

Alcon, Avila College, Kansas City. Sponsored by Astronomical League. Contact Carroll Jorg, 7241 Jarboe, Kansas City, 64114, (816) 444-4878.

Newfoundland

RASC General Assembly, Terra Nova National Park, St. John's. Sponsored by RASC-St. John's Centre. Contact Randy Dodge, 206 Frecker Dr., St. John's, A1E 5H9, (709) 745-2903 or Email: randy@kean.ucs.mun.ca.

Ohio

OTAA Convention, Oberlin College, Oberlin. Sponsored by Cuyahoga Astronomical Association. Contact Mike Williams, P.O. Box 29089, Cleveland, 44129-0089, (216) 235-9193.

Ohio

OTAA Regional Star Party, Indian Hill Observatory, Huntsburg. Sponsored by Chagrin Valley Astronomical Society. Contact Bob Modic, (216) 731-0522.

Québec

Annual Telescope Making Contest, Parc Des Iles, St-Timothea. Sponsored by Club de l'Astronomie Orion. Contact Yvan Prigent, 409 Jacques-Cartier, Valleyfield, J6T 4T7.

AUGUST

Alberta

Alberta Star Party, Calgary. Sponsored by RASC - Calgary Chapter. Contact Ruth Lewis, P.O. Box 2100, Station 'M', Calgary, T2P 2M5, (403) 283-0570.

Arizona

Mt. Magazine Star Party, Russellville. Sponsored by River Valley Stargazers. Contact Rex McDaniel, P.O. Box 261, Dover, 72837, (501) 331-3620.

California

Annual Perseid Meteor Watch Star Party and Picnic, Santa Barbara. Sponsored by Santa Barbara Astronomical Society. Contact Clyde Kirkpatrick, 6409-A Camino Vista, Goleta, 93117, (805) 685-2705.

California

Annual Star B Q, Fremont Peak. Sponsored by Astronomical Association of Northern California. Contact Don Stone, 731 Camino Ricardo, Moraga, 94556, (510) 376-3007.

Indiana

The Center of the Milky Way, Lemon Lake County Park, Crown Point. Sponsored by Calumet Astronomical Society. Contact Stephen Miller, 940 N. Broad St., Griffith, 46319, (219) 845-9174.

Idaho

Southern Idaho Regional Star Party, Brimdeau Dunes State Park, Mt. Home. Contact Richard Beaver, P.O. Box 8386, Boise, 83707, (208) 377-5220.

Massachusetts

Solar Awareness, Plymouth Public Library, Plymouth. Sponsored by Star Searchers Astronomy Club. Contact Roy Zahrecivan or Susan Moore, P.O. Box 255, White Horse Beach, 02381-0255, (617) 834-9866.

Michigan

Open House, James C. Veen Observatory, Lowell. Sponsored by Grand Rapids Amateur Astronomical Association. Contact Evelyn Marron, 3308 Kissing Rock Rd., S.E., Lowell, 49331, (616) 897-7065.

Michigan

Southern Michigan Universal Regional Festival of Stargazers. Sponsored by Genesee Astronomical Society. Contact Richard Walker, Robert T. Longway Planetarium, 1310 E. Kearsley St., Flint, 48503, (810) 627-9524.

Minnesota

Annual Star Party, Sola Fide Observatory, Austin. Sponsored by Cedar River Astronomy Club. Contact Keith Snyder, 407 15th St. S.E., Austin, 55912, (507) 433-1903.

Nebraska

Prairie Astronomy Club Picnic, Prairie Astronomy Atlas Site, Lincoln. Sponsored by Prairie Astronomy Club. Contact John Bruce, P.O. Box 80553, Lincoln, 68501, (402) 465-2246.

New York

Annual Summer Seminar, Tully. Sponsored by Syracuse Astronomical Society, Inc. Contact Raymond Dague or Joe Italiano, 1115 E. Colvin St., Syracuse, 13210, (315) 478-7032.

North Dakota

Annual Meeting, Theodore Roosevelt National Park, North Unit, Medora. Sponsored by Dakota Astronomical Society. Contact Eric Raveling, 9115 Baine Dr., Bismarck, 58501, (701) 224-8420.

Ohio

O.T.A.A. Annual Convention, Mahoning Valley Observatory, Newton Falls. Sponsored by Mahoning Valley Astronomical Society. Contact Mark A. Baker, 1076 S. R. 534, Newton Falls, 44444.

Oklahoma

Gloss Mts. Annual Star Party, Enid. Sponsored by Northwest Oklahoma Astronomy Club. Contact Dan Mathews, 1719 Pawnee, Enid, 73703.

Rhode Island

Annual Star Party, Jerimoth Hill. Sponsored by Celestial Observers of Rhode Island. Contact Ken Conca, 95 Rome Ave., Providence, 02908, (401) 351-5676.

Virginia

Perseid Meteor Watch, Sky Meadows State Park, Paris. Sponsored by Shenandoah Astronomical Society. Contact Bill Warren, P.O. Box 47, Lord Fairfax Community College, Middletown, 22645, (703) 459-3510.

Vermont

Convention at Stellafane, Springfield. Sponsored by Springfield Telescope Makers. Contact Bob Morse, RR #2 Box 68A, Walpole, 03608, (603) 756-4572.

Wisconsin

Northwoods Starfest, Hobbs Observatory, Fall Creek. Sponsored by Chippewa Valley Astronomical Society. Contact Bob Elliott, Rt. 2 Box 94, Fall Creek, 54742, (715) 877-2657.

Wyoming

CAS Weekend Under the Stars, Winter Sports Parking Lot, Fox Park. Sponsored by Cheyenne Astronomical Society. Contact Martin D. Curran, 6614 N. College #G, Cheyenne, 82009, (307) 777-7539.

SEPTEMBER

Arizona

Arizona Star Party. Sponsored by Phoenix Astronomical Society. Contact Leon Knot, 1021 S. Revere, Mesa, 85202, (602) 461-1758.

Connecticut

Connecticut Star Party, Camp Bobriwka, Colebrook. Sponsored by Astronomical Society of New Haven. Contact Joel Marks, P.O. Box 5032, Milford, 06460, (203) 974-4816.

Illinois

Astrofest, Camp Shaw-Waw-Nas-See, Kankakee. Sponsored by Chicago Astronomical Society. Contact Astrofest, P.O. Box 596, Tinley Park, 60477.

Indiana

NIAGfest, North Webster. Sponsored by Michiana Astronomical Society and Warsaw Astronomical Society. Contact Kurt Eberhardt, 3370 E. Kenway Dr., Warsaw, 46580.

North Carolina

Annual Blue Ridge Parkway Regional Stargaze, Julian Price Park, south of Blowing Rock. Sponsored by Catawba Valley Astronomy Club. Contact Greg Kirby, 5026 Poplar View Ln., Granite Falls, 28630, (704) 966-7656.

Pennsylvania

Megameet, Pulpit Rock Astronomical Park, near Hamburg. Sponsored by Lehigh Valley Amateur Society, Inc. Contact Priscilla Andrews, P.O. Box 262, Kutztown, 19530, (610) 683-6397.

Virginia

Northern Virginia Telescope Meet, C. M. Crockett Park, Calverton. Sponsored by Northern Virginia Astronomy Club. Contact Martha Krause, 2520 Rocky Branch Rd., Vienna, 22181, (703) 281-9049.

OCTOBER

Arizona

All Arizona Star Party, Arizona City. Sponsored by East Valley Astronomy Club. Contact Ted Heckens, 507 E. Ivy, Mesa, 85203, (602) 827-1524.

Kansas

NEKAAL Annual Awards Banquet and Workshop, Perry State Grange, Perry. Sponsored by Northeast Kansas Amateur Astronomers' League, Inc. Contact Brenda Culbertson, 681 Frog Hollow, Harveyville, 66431, (913) 589-2405.

Mississippi

Deep South Regional Star Gaze, McComb. Sponsored by Jackson Astronomical Association. Contact Mike Lang, 703 Lomont St., Pearl, 39208, LA (601) 968-5292.

Mississippi

Deep South Regional Star Gaze, Percy Quinn State Park. Sponsored by Pontchartrain Astronomy Society. Contact Mike Sandras, 948 Ave. "E," Westwego, 70094, (504) 468-7229.

New York

Annual Astronomy Jamboree, Southold. Sponsored by Custer Institute Inc. Contact Barbara Lebekeucher, Herricks Lane Box 645, Jamesport, 11947, (516) 722-3850.

New York

Astronomy Festival, Kopernik Space Education Center, Vestal. Sponsored by Kopernik Astronomical Society. Contact Jay Edwards, 16 Irishtown Rd., Newark Valley, 13811, (607) 748-3685.

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Annual Blue Ridge Parkway Regional Stargaze, Julian Price Park, south of Blowing Rock. Sponsored by Catawba Valley Astronomy Club. Contact Greg Kirby, 5026 Poplar View Ln., Granite Falls, 28630, (704) 396-7656.

North Carolina

East Coast Star Party, Coin Jock. Sponsored by Back Bay Amateur Astronomers. Contact Kent Blackwell, 1169 Old Kempsville Rd., Virginia Beach, 23464, (804) 495-4663.

Pennsylvania

Stella-Della, Ottsville. Sponsored by Bucks-Mont Astronomical Association. Contact Edward Melnick, 1443 Devon Rd., Warminster, 18974, (215) 443-7929.

Québec

Camp N.D.M., Notre-Dame-de-la-Merci. Sponsored by Club des Astronomes Amateurs de Laval. Contact Jean-Marc Richard, C.P. 214 Succ. St-Martin, Laval, H7V 3P5, (514) 625-5527.

Tennessee

Bays Mountain Starfest, Kingsport. Sponsored by Bays Mountain Amateur Astronomers. Contact Mike Chesman, 853 Bays Mountain Park Rd., Kingsport, 37660, (615) 229-9447.

Virginia

Virginia Assoc. of Amateur Astronomical Societies - Annual Convention, Science Museum of Western Virginia, Roanoke. Sponsored by Roanoke Valley Astronomical Society. Contact Frank E. Baratta, 2607 Oregon Avenue S.W., Roanoke, 24015, (703) 334-2781.

NOVEMBER

Florida

Star Fest, Chiefland. Sponsored by Astro Scopers. Contact Joanne Klein, 8350 81st N, Seminole, 34647, (813) 397-4235.

Indiana

The Moon & Saturn, Lemon Lake County Park, Crown Point. Sponsored by Calumet Astronomical Society. Contact Steve Miller, 940 North Broad St., Griffith, 46319, (219) 845-9174.

Louisiana

Deep South Regional Star Gaze, Baton Rouge. Sponsored by Baton Rouge Astronomical Society and Ponchartrain Astronomical Society. Contact Barry Simon, (504) 283-7592.

CREDITS

p. 82, left to right: Science Center of Iowa; Stellafane by David J. Eicher; Fleischmann Planetarium; partial solar eclipse viewing by John Morgan; **p. 84:** Lowell Observatory by Geoff Chester; **p. 85:** Fiske Planetarium by J. Martin Natvig; **p. 86:** Winter Star Party by Robert Burnham; **p. 87:** Astrofest by Alan Dyer; **p. 88:** Louisville Science Center; **p. 89:** Michigan Space Center; **p. 90:** Museum of the Rockies; **p. 91:** Fleischmann Planetarium; **p. 92:** Hayden Planetarium; **p. 93:** Okie-Tex Star Party by Clive Cady; **p. 94:** The Columbia Museum of Art by Costas Crawa; **p. 95:** McDonald Observatory by Terry Atwood; **p. 96:** Yerkes Observatory by Alan Dyer.

Altazimuth mount: A telescope mount that allows a telescope to swing up and down (altitude) and side to side (azimuth).

Angular distance: The angle between two celestial objects as measured by an observer.

Asteroid: Any of the small, rocky bodies left over from collisions of larger clumps of matter in the early solar system, technically called a minor planet. About 95 percent of all asteroids reside in the asteroid belt, a zone between the orbits of Mars and Jupiter.

in a highly elongated orbit. When a comet approaches the Sun, its ices turn directly into gas, forming a cloud of gas and dust that glows in the night sky.

Conjunction: An alignment of two solar system bodies that makes them appear close together in the sky.

Constellation: A pattern of stars historically said to represent a person, animal, or thing. The term also refers to the region of sky containing this pattern.

Declination: A coordinate similar to terrestrial latitude that measures the angular distance between a celestial body and the celestial equator.

Ecliptic: The path of the Sun across the sky. The Moon and the major planets follow paths that lie very near the ecliptic.

Elongation: The angular distance (as measured from an observer) between the Sun and a planet or a planet and one of its satellites.

Equatorial mount: A telescope mount with one axis parallel to Earth's rotational axis. It allows a telescope to track the motion of the stars in the sky.

Galaxy: A large collection of stars, gas, and dust held together by gravity that travels together through space. Galaxies exist in many sizes and shapes, but most fit into five basic classes: ellipticals, spirals, barred spirals, lenticulars, and irregulars.

Light-year: The distance traveled by light in one year. Traveling at a speed of 186,000 miles per sec-

ond, light covers about 6 trillion miles in a year.

Lunar eclipse: The darkening of all or part of the Moon that occurs when the Moon passes into Earth's shadow.

Magnitude: A measure of the brightness of a celestial object. Magnitudes are measured on a logarithmic scale with smaller numbers representing brighter objects.

Meteor: A streak of light in the night sky seen when a meteor enters Earth's atmosphere.

Meteorite: The portion of a meteoroid that survives its passage through Earth's atmosphere and strikes the ground.

Meteoroid: A particle of rock or dust orbiting the Sun in interplanetary space.

Nebula: A glowing gas cloud or opaque cloud of dust inside a galaxy. Nebulae are connected with both ends of stellar evolution: That is, stars are born out of gas clouds called emission nebulae, and they can die by shedding a gaseous shell called a planetary nebula or by exploding as a supernova, which produces a nebula called a supernova remnant.

Opposition: A configuration in which Earth passes between the Sun and a planet so the planet appears opposite the Sun in the sky. At opposition a planet rises at sunset, is highest in the sky at local midnight, and sets at sunrise.

Parsec: A unit of distance equal to 3.26 light-years, or about 20 trillion miles.

Reflector: A telescope that uses a mirror to gather and focus incoming light.

Refractor: A telescope that uses a lens to gather and focus incoming light.

Right ascension: A coordinate similar to terrestrial longitude that measures the angular distance of a celestial body eastward along the celestial equator from the vernal equinox.

Satellite: Any body that orbits a planet, also informally called a moon.

Solar eclipse: The darkening of part of Earth that occurs when Earth passes into the Moon's shadow and all or part of the Sun disappears from view.

Star cluster: A group of stars gravitationally bound that travels together through space. Open star clusters are small, irregular groups of several dozen to a few hundred young stars that form inside galaxies. Globular star clusters are large, spherical collections of hundreds of thousands of old stars lying in the halos, or outer regions, of galaxies.

Universal time (UT): A system of time reckoning used by astronomers around the world. UT is based on a 24-hour clock and is equal to the standard time at Greenwich, England.

Zenith: The point on the celestial sphere directly over an observer's head.

Zodiacal light: A faint illumination centered on the ecliptic seen in the east before morning twilight and the west after evening twilight. It is faintly visible from a dark sky site.

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Eicher, David J. *Beyond the Solar System; 100 best deep-sky objects for amateur astronomers.* 80 pp., paper, 1992. An introduction to the brightest and most spectacular of the sky's nebulae, clusters, and galaxies.

Eicher, David J., ed. *Galaxies and the Universe; an observing guide from Deep Sky magazine.* 80 pp., paper, 1992. A collection of articles on observing galaxies.

Eicher, David J., ed. *Stars and Galaxies; ASTRONOMY's guide to exploring the cosmos.* 200 pp., hardcover, 1992. Forty articles centered on unusually rich regions of sky, with hundreds of photos, sketches, and diagrams.

Eicher, David J. *The Universe from Your Backyard.* 188 pp., hardcover, 1988. Forty-six constellations or groups of constellations and 690 deep-sky objects. A three-color map, eyepiece sketches, and color photographs appear for each constellation.

Harris, Joel, and Richard Talcott. *Chasing the Shadow; an observer's guide to eclipses.* 160 pp.,

paper, 1994. A guide to the best places, times, and equipment for observing every solar eclipse of the coming decade. Appendices provide detailed maps for upcoming eclipse events.

Kitt, Michael T. *The Moon; an observing guide for backyard telescopes.* 80 pp., paper, 1992. Photos, observing tips, and guided tours of many lunar regions. Aimed at the small telescope user but includes ample information for large telescopes.

The New Cosmos; the astronomy of our Galaxy and beyond. 160 pp., paper, 1992. Some of the best material from ASTRONOMY magazine, with a hard look at the cutting edge of astronomical research, including much on galaxies. Includes such topics as black holes, quasars, life elsewhere in the universe, and technologically advanced telescopes.

Rükl, Antonin. *ASTRONOMY Atlas of the Moon.* (T.W. Rackham, ed.) 224 pp., hardcover, 1992. A marvelously detailed cartographic Moon map covering the lunar surface in 76 sections, with descriptions at a crater-by-crater level of detail.

ASTRONOMY. World's largest English-language astronomy periodical, 1973-. Plentiful information about observing, astrophotography, celestial objects, amateur astronomy events and meetings, and the latest in the science of astronomy.

Burnham, Robert. *The Star Book.* 17 pp., spiral-bound, 1983. A group of seasonal star maps from ASTRONOMY magazine also presents a brief discussion of what to see.

Eicher, David J. *Beginner's Guide to Amateur Astronomy; an owner's manual for the night sky.* 166 pp., paper, 1993. A sweeping overview of the hobby of astronomy, from choosing binoculars or a telescope to observing and photographing the Sun, Moon, planets, comets, asteroids, star clusters, nebulae, and galaxies. Includes information on clubs and star parties.

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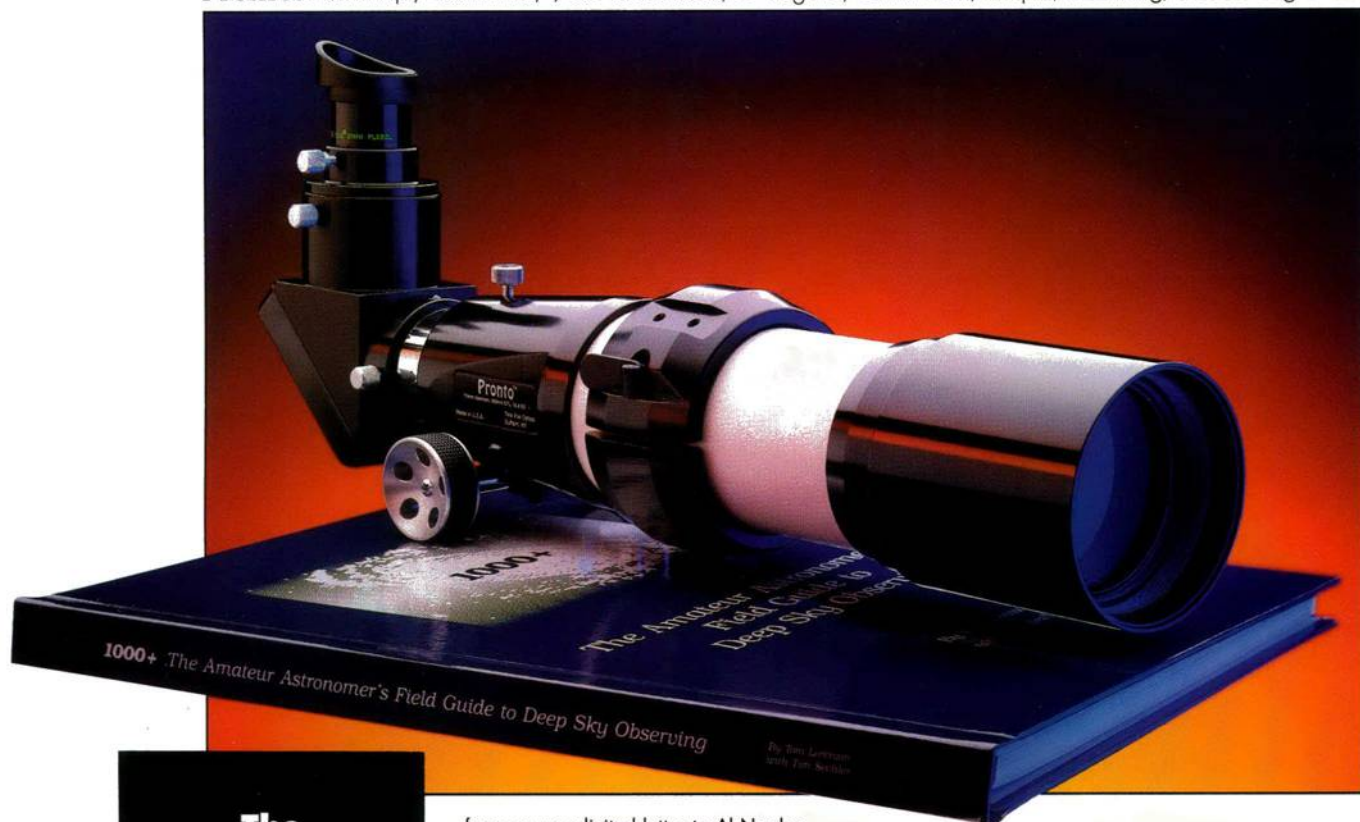
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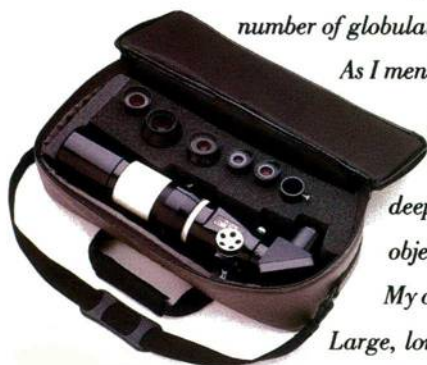
As I mentioned before, the 30x eyepiece is my favorite for sweeping the Milky Way. I ended up using 50x for larger objects; 75x for 'ordinary' deep-sky viewing. A few high surface brightness objects were viewed to advantage at 110x, & I used 150x on double stars.

My observations show that from a true-dark site, the telescope is a real performer.

Large, low surface brightness objects are routinely visible; even I was surprised by the visibility of NGC 147. Using the stars plotted on Uranometria, I traced the Andromeda galaxy to 4° length on two nights." — Brian Skiff, Author & Astronomer



Pronto photo of Eta Carina by Ralph Sieger



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Hand-figured Schmidt-Cassegrain optical system for the ultimate in optical quality

- HR coating on primary and secondary mirror for increased reflectivity
- AR coating on corrector for increased light transmission

5" aperture offers 100% more light gathering power as 3.5" telescopes and more than 50% the light gathering power of competing 4" telescopes

C5 tube doubles as terrestrial spotting scope or a 1250mm f/10 telephoto lens – tube weighs only 6 pounds!

Two preloaded ball bearings for rigid support with smooth movement

Quick release mechanism allows you to remove the telescope from the fork time in seconds with no tools

Convenient carrying handle

Heavy-duty table top wedge adjustable from 0° to 90°

Piggyback Platform

5x24 Finderscope

Uses 1-1/4" Eyepieces

Preloaded tapered roller bearings on the polar axle

Self contained drive base with drive controller electronics for celestial photography – all powered by a single internal 9-volt battery that runs the telescope for 50 hours

Bubble Level

Leveling Screws

Hand Controller

Compact 9"x20"x20" system allows you to take it virtually anywhere, from your backyard to a remote observing site – weighs just 23 pounds, wedge included!

For a brochure contact your local Celestron dealer or Celestron International directly

... Everything You Want in a Telescope



CELESTRON®

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310/328-9560 310/212-5835 (FAX)

LIGHT YEARS AHEAD OF THE COMPETITION